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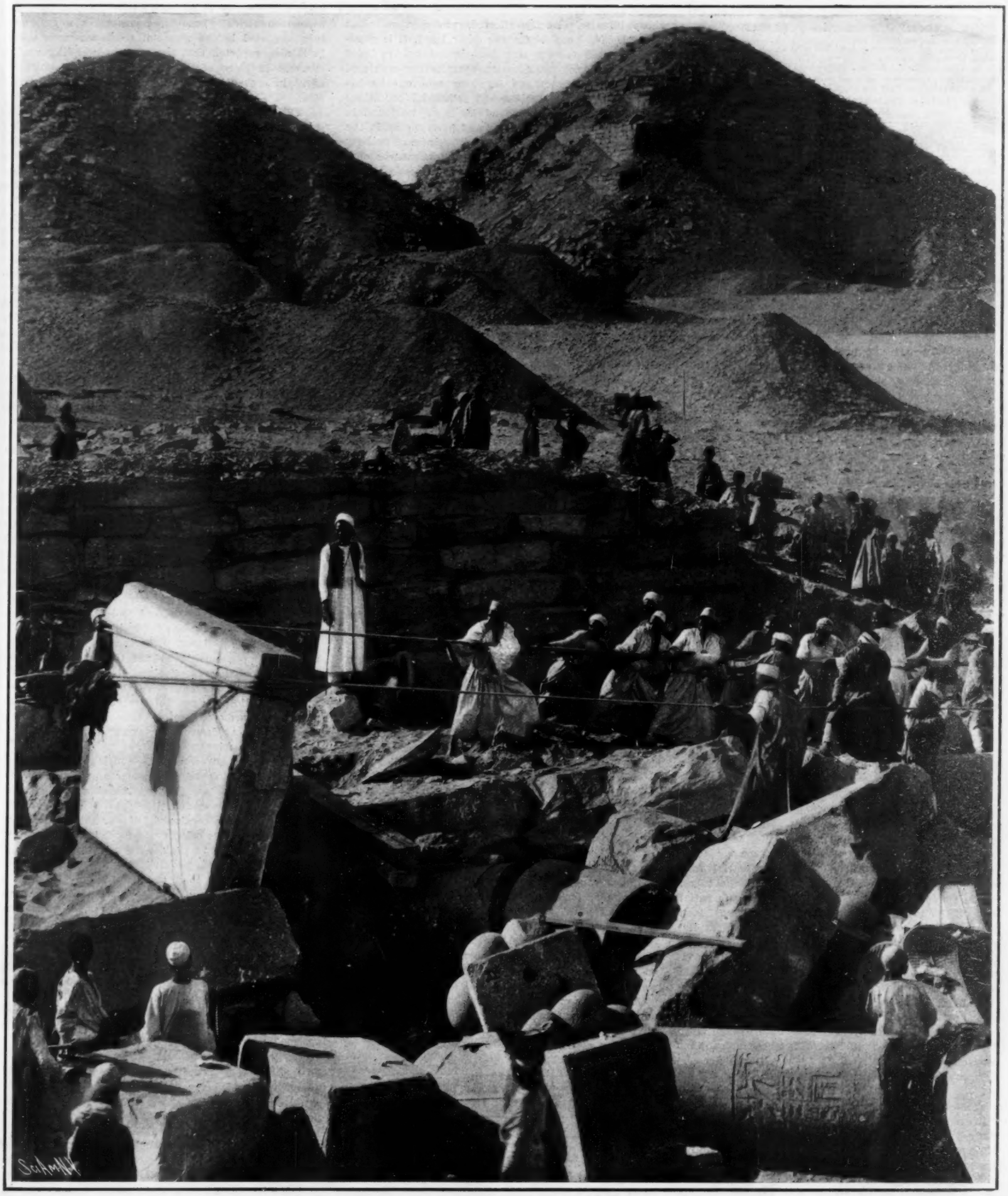

The Ruins of an Arcade in the Temple of King Sahure Near Abusir (About 2500 B. C.)

THE EXPLORATIONS OF THE GERMAN ORIENT SOCIETY.—[See page 293.]

SCIENTIFIC AMERICAN

ESTABLISHED 1845

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NEW YORK, SATURDAY, APRIL 25, 1908.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

REINFORCEMENT OF THE BROOKLYN SUBWAY TUNNELS.

In view of the popular distrust of the Subway tunnels to Brooklyn, which was aroused at a certain period during their construction, a distrust which it took several weeks of successful operation to dissipate, we present some details of the method of strengthening the tunnels during construction, which should be sufficient to satisfy the public once and for all not only that the tubes are "safe" but that they are stronger than as originally designed.

The irregularity in the grades of a certain part of the tunnel and the deformation of the cast-iron shell were caused by faulty control of the shield in the process of driving, coupled with an undoubted weakness of the cast-iron tube for the stresses it was called upon to sustain when it entered the loose material below the river. The irregularities of grade and weakness of the shell were, fortunately, capable of correction; and the engineers of the Interborough Company spared neither time nor expense in repairing the defects and putting this portion of the tubes in first-class condition. To prevent any tendency of the tubes to sag in the direction of their length, 20-inch steel-and-concrete piles were sunk, in pairs, at 30-foot intervals longitudinally of the tube, the piles being carried down to solid rock or other firm material. The grade was corrected by enlarging the tunnel at the top or bottom, as might be required, until a perfectly true grade was established. An immense amount of work was done also to strengthen the tubes against distortion where they passed through the soft material. The concrete lining was here made thick enough to extend 3 inches beyond the flanges of the lining plates, and it was specially increased in thickness at the top of the tunnel and the sides, by making the outline flat instead of circular at these places. Inside of this extra concrete and around the top of the arch for a distance of 120 degrees circumferentially, there were imbedded three 1¼-inch round rods to each segmental ring of the tubes. Also, at the top of the tunnel there were imbedded sixteen longitudinal 1¼-inch round rods connected at their ends by turnbuckles. A similar number of circumferential rods were imbedded in the bottom concrete of the tubes. On each side of the tubes, lapping the circumferential rods at the top and bottom, were placed two 1-inch square rods to each ring. It will be seen that the cast-iron lining of the tunnel is thus reinforced by what is practically a second shell of steel and concrete. So closely assembled are the steel bars and rods, that in some cases the concrete had to be put in place by hand, and extreme care was taken to secure a thorough bond between the materials. Whatever grounds for anxiety may have once existed as to the stability of the tunnel have by these precautions been entirely removed.

THE PANIC AND THE RAILROADS.

Few people who are not directly connected with the railroad interests of this country appreciate how seriously they were affected by the panic at the close of last year. It came at a time when the development of our railroad system, in the extent of its mileage, the magnitude of its rolling stock, and the enormous extent of its freight and passenger traffic, had reached a point that was undreamed of a few years ago, even by our most optimistic railroad men. In spite of the fact, as shown by the Interstate Commerce Commission reports, that there were over 223,000 miles of line in the country served by nearly 2,000,000 freight cars of 70,000,000 tons aggregate capacity, there was no little anxiety lest another car famine, similar to that of a few years before, should occur. In the closing months of last year, however, the tide of new construction and increasing freight and passenger traffic was suddenly halted and commenced to swiftly ebb—how swiftly is shown by the fact that at the opening of the present year there were over 300,000 idle freight cars on the various railroads, while the returns made to the Interstate Commerce Commission reveal that, in the last three months of 1907, while the ratio of expenses to earnings had risen from 67 per cent to 76 per cent, there had been a decrease of earnings per mile of 31 per cent. According to an estimate of Mr. S. Thompson, prepared for the General Managers' Association of Chicago, there were recently about 340,000 railway employees out of work, whose idleness directly affected, probably, not less than 1,500,000 people. On the other hand, it is gratifying to learn from a statement issued by the Chief of the Bureau of Immigration that, as the result of several hundred thousand inquiries sent out by his office, to determine the present industrial conditions and the probability of demand for labor, he found in almost every industrial center and particularly in the farming districts signs of a steady return of activity and the probability during the next few months of a steadily increasing demand for labor.

REPORT ON THE QUEBEC BRIDGE DISASTER.

Probably no great engineering disaster has been made the subject of such an exhaustive inquiry as the fall of the Quebec Bridge. For five months the Royal Commission of Inquiry was continuously engaged in its investigations, and the report which has recently been made public is one of the most voluminous and valuable documents of the kind ever presented. In the current issue of the SUPPLEMENT will be found a lengthy summary of the conclusions reached by the Commission, which finds that the collapse of the bridge was due to the failure of the lower chords in the anchor arm, near the main pier, and that the failure of these chords was due to their defective design. The stresses that caused failure did not result from abnormal weather conditions or accident, but were such as might be expected in the regular course of erection. The work done by the bridge company in making the detail drawings, in planning and carrying out the erection, and in fabricating the material was good, and the steel used was of good quality. The Commission finds that the failure cannot be attributed to any cause other than errors of judgment on the part of the designing and the consulting engineers connected with the construction of the bridge; although they state that these errors of judgment cannot be attributed either to lack of common professional knowledge, the neglect of duty, or to the desire to economize. The ability of the two engineers was tried in one of the most difficult professional problems of the day, and proved to be insufficient. The Commission considers that the specifications were not satisfactory, the unit stresses employed being higher than any established by past practice. A grave error was made in assuming the dead load at too low a value. This error alone was of sufficient magnitude to have required the condemnation of the bridge, even if the details of the lower chords had been of sufficient strength; for the actual stresses in the completed bridge would have been considerably greater even than the high stresses permitted by the specification. There is one clause which will be of particular interest to bridge engineers, and we are inclined to think will call forth no little protest. This occurs toward the close of the report, where the Commission states that the professional knowledge of the present day concerning the action of steel columns under load is not sufficient to enable engineers to economically design such structures as the Quebec Bridge. Now, although the SCIENTIFIC AMERICAN is free to admit that our knowledge of the strength of large steel compression members is not as accurate as might be desired, we are satisfied that, if the weight of steel which was used in the bottom chord member that failed had been built up in a form better adapted to resist compressive loads, the bridge would have been standing to-day—though subjected, of course, to higher stresses than are sanctioned by the best modern practice.

URGENT NEED OF FOREST PRESERVATION.

We direct attention to the article on another page of this issue describing the practical work of the Bureau of Forestry. That the case is urgent is shown by the estimate made by the Forest Service of the United States that, at the present rate of consumption, and taking no account of renewals of growth, which require on an average about thirty-five years, the timber supply of this country will be totally exhausted in fourteen years. This is based on an estimate that the total stand of timber in the United States is 1,400 billion and that the annual use of timber to-day is one-fourteenth of this amount or 100 billion feet. The Forest Service is directing its efforts to the preservation of this timber supply by creating national forests and disseminating information as to the best way in which forest resources may be utilized. According to Mr. Herbert M. Wilson, of the United States Geological Survey, the great hope for the preservation of our timber supplies lies in teaching the people how to scientifically manage the forest and prevent waste; and he summarizes the method to be adopted as follows: The putting to use of every part of each tree that is cut; the stopping of forest fires; the prevention of wasteful bark cutting, and the employment of means to preserve the life of the timber after cutting in the various uses to which it is put. It is encouraging to learn that prompt action, such as is being encouraged by the Bureau of Forestry, may place this country in an even better position than European countries, whose forest resources were practically depleted before remedial measures were taken. It is also expected that the rapidly-extending use of concrete in place of wood will serve as a powerful agent in preventing the extermination of our forests.

THE BRITISH NAVAL PROGRAMME FOR 1908.

Though the naval appropriation made by the British government for the year 1908 represents a slight increase upon the estimate of last year it is considerably below what it was four years ago, which marked the high-water mark in British naval production. For the current year the total sum to be devoted to naval purposes is $161,597,500, of which $37,726,010 is to be expended upon new construction. The new programme, which in the words of the First Lord of the Admiralty is "exceedingly modest," comprises the building of one battleship of the improved "Dreadnought" class, one large armored cruiser, six fast protected cruisers, sixteen torpedo-boat destroyers, and a number of submarines to the estimated value of $2,500,000. In regard to the latter the Admiralty has entered upon a new policy, that is the construction of this class of craft in the government dockyards, the object being thereby to keep a check upon private contracts. Moreover the department has come to an arrangement with the leading armor-plate manufacturers whereby a considerable reduction in the price of armor has been effected and this development will exercise an appreciable reduction in the cost of warship construction.

Though only one vessel of the "Dreadnought" class is to be laid down during the present year the British Admiralty has already, including vessels of the "Lord Nelson" and "Agamemnon" class which coincide with the all-big-gun type of warship, nine of these vessels launched, while three are in course of construction and two more are authorized, making fourteen units of this type in all.

Between April 1, 1907, and March 31, 1908, twenty-six warships have been completed and placed in commission. These comprise one battleship ("Lord Nelson"), three armored cruisers, three torpedo-boat destroyers of the new ocean-going 33-knot turbine type, ten torpedo boats of the coastal class, eight submarines, and the repair ship "Cyclops." At the present time there are also building sixty further vessels—seven battleships, four armored cruisers, one unarmored cruiser, ten torpedo-boat destroyers, twenty torpedo boats, and eighteen submarines.

The present government is continuing the general lines of the policy of the former administration, the results of which are now commencing to bear fruit. The nucleus-crew system has proved highly satisfactory and is to be continued. Under this arrangement the chief executive officers and more important ratings are always on board the vessels when out of commission. From time to time the full crews are made up and are subjected to a course of sea-going practice, while the machinery and boilers are always maintained in first-rate condition. The result is that such vessels are always ready for instant mobilization, and the wisdom of this arrangement has been strongly exemplified during the past few months, when vessels with such nucleus crews have been suddenly called out for an emergency and have been able to reply to the summons with the minimum of delay.

In regard to the establishment of the new dockyard at Rosyth on the east coast of Great Britain, $17,250,000 is to be devoted during the current year toward the construction and equipment of this strategical point. The property acquired aggregates 1,184.2 acres with 285 acres of foreshore. A superintendent engineer was appointed for the purpose of studying the various great dockyards throughout the world together with their equipment, so that Rosyth might be replete with the most modern appliances and when completed constitute the finest and largest naval port extant. As a result of his investigations a general scheme has been drawn up in such a manner that any section or sections might be carried to fulfillment at once without interfering with the general aspect of the whole idea. The Admiralty proposes to push forward with the construction of a great graving dock, closed basin, and an entrance lock with a depot for

submarines, destroyers, and oil storage, as liquid fuel is to be so extensively adopted in the navy in future. The basin is to have an area of 52.5 acres, with accommodation for eleven of the largest warships along the quays, and twenty-two when double-banked. Special attention has been paid to the rapid strides that are being effected in naval design, and the dockyard is being constructed rather with a view to future requirements than to present-day exigencies. The present appropriation is intended to cover the cost of the necessary pier constructional work, the contract for which is to be shortly let and which it is anticipated will be completed in ten years.

DELAGRANGE'S RECORD AEROPLANE FLIGHT.

On April 11 M. Delagrange, the French sculptor who has been experimenting latterly with an aeroplane which is practically a duplicate of M. Farman's machine, is said to have made a circular flight of about 4½ miles above the parade ground of Issy-les-Moulineaux, near Paris.

Following a triangular course, the aeroplane touched ground twice in the first two rounds, but made the last 3 miles in 6½ minutes without touching and at a height of about 12 feet. The flight lasted 9¼ minutes, and is said to have been terminated on account of M. Delagrange becoming fatigued from operating so continuously the horizontal rudder. The two rudders of his aeroplane are controlled by a single steering wheel. This wheel is turned in one direction or the other to operate the vertical rudder and steer the aeroplane to the right or to the left, while by pushing forward or pulling backward on the wheel, the horizontal rudder is moved, and the machine made to rise or fall. While in flight, it is necessary for the aviator to constantly manipulate the horizontal rudder, in order to keep the machine at a fairly even height above the ground. The working of this rudder is rather an arduous task, besides being a great strain upon the nerves of the operator. It is interesting to note that the flight was terminated for the cause stated, and not on account of the overheating of the motor, which has been the cause of the termination of most of Farman's flights. The Delagrange aeroplane is fitted with a radiator and pump for properly cooling the water, and it is doubtless on this account that it was possible to accomplish so long a flight. The experience of M. Delagrange shows that some better way of operating the horizontal rudder must be provided, or better still, that a machine which is automatically stable must be built before very long flights are accomplished. It has also brought out the fact that the operation of a flying machine is no child's play, but a very great strain upon the nerves and muscles of the aviator. The covering of so long a distance after but very little practice was quite unlooked for, and only goes to show how very near the solution of the problem we are at the present time.

IMPROVEMENT OF THE AMERICAN MERCHANT MARINE.

BY WILLIAM P. MUNGER.

In 1905 Admiral Dewey, in a letter to the Secretary of the Navy, gave twenty good reasons why, as viewed from a military standpoint alone, the merchant marine of the United States should be augmented. After commenting on the deplorable condition of our merchant marine, showing the difficulty of getting auxiliary vessels at the outbreak of the late Spanish war, pointing out that the embarrassment would have been still greater if the operations of war had been more unexpected and against a more active enemy, describing the negative support that would be and is given the navy by the merchant marine, he remarks that another benefit accruing to the navy from a larger fleet of American-owned merchant vessels would be a large number of experienced seafaring men, forming a valuable reserve with which to man auxiliaries.

We are now carrying 8 per cent to 12 per cent of our exports and imports in American bottoms, which means that we are intrusting our rivals with the delivery of our goods. Can we expect our rivals to be as careful in handling or as prompt in delivering our goods as their own? The testimony of the manufacturers of the entire country before the Merchant Marine Commission of 1906 shows that American merchants find it hard to get into the South American markets, and harder still to stay there; for they can never depend upon the starting of English and German vessels. The American mails must cross the Atlantic twice on the subsidized liners of England. The result is the inevitable one. We have lost our hold upon South America. Likewise our prestige has been and is being lowered in the Orient and the Occident.

Among the various plans which have been proposed to strengthen our merchant marine, the following stand out as the most often discussed: Free ships, discriminating duties, bounty to ship owners building ships, larger compensation for carrying mails, and subsidy.

Free ships mean (1) free trade, because that method allows all materials entering into the construction or repair of ships engaged in foreign trade to be imported free of duty. The objections to this are: First. That all materials entering into the construction or repair of ships are now, by the provisions of the Dingley law, upon the free list; and this method has not built up our merchant marine. Second. That this policy would not help the merchants to pay increased running expenses after ships were built. (2) The building of ships in a foreign country and putting them under the American flag. This is a bad policy, because, even if the ships were just as well built, American labor would be deprived of all that work and pay.

Discriminating Duties.—The objections to the policy of (1) remitting to consignees a certain percentage of the duties upon goods if imported in American bottoms, or (2) of imposing an additional duty if carried in foreign bottoms, or (3) of so modifying the tonnage tax laws that American ships would pay less tax than those of a foreign nation, are: First. It would not benefit our very large export trade. Second. It would necessitate the abrogation of thirty commercial treaties, and to secure thirty more as favorable would be an almost impossible task. Third. The probability of retaliation by other nations is far too serious a risk to be taken. Fourth. The quantity of goods on each voyage would vary, and the ship owner could not be sure business would be sufficiently remunerative to warrant him in building and running vessels under this plan. Fifth. It is not general in application, as many of the ports that we wish to make our free trade ports, or the articles carried, are now on the free list.

Bounty to Ship Owners Building Ships.—This plan, in its best form, advocates the payment of a bonus to ship owners when new ships are commissioned from American yards, this amount bringing the net cost down to the foreign builder's figures. This plan would in no way bring down running expenses to the low figure of the heavily-subsidized foreign merchant marine. It would be like deserting a child at its birth.

Larger Compensation for Carrying Mails.—Mail subventions tend to build up fast steam lines with little cargo capacity, and to increase the compensation would probably drive our already too few steam "tramps," the large and slow cargo sailing vessels, and the deep-sea fishing vessels out of business.

Subsidy is an equalization to ship owners for the yearly loss sustained by the increased cost of running under the American flag, the American laws requiring better housing and better food for the crew than the laws of foreign nations. The forms which a subsidy plan usually assumes are: (1) A direct payment to ship owners per ton of freight per mile. (2) A direct payment per registered ton-mile. (3) A direct payment per gross ton-mile. (4) A payment based on the number of days the vessel is engaged in foreign trade.

1, 2, and 3 would not be applicable to deep-sea fishing boats, while No. 4 puts the American ship in a position to compete with the foreign ships, all of which have lower operating expenses. But it does not help the ships to spring into existence. As none of the above will by itself solve the problem, there is proposed, as a composite measure:

(1) A bounty paid to ship owners building ships of 40 per cent of the gross cost of all ships built for the foreign trade the first year, 30 per cent on all built the second year, 20 per cent on all built the third year, 10 per cent on all built the fourth, and none thereafter. This plan would enable American capital to secure ships as cheaply here as abroad. Since American workmanship excels, this would create a demand for American ships, and give work to American shipyards and jobs to American labor. The more ships that are built, the more thoroughly organized the shipyards would become, and hence the lessened cost, and hence the diminishing rate of bounty.

(2) A greater mail compensation paid to lines of fast American mail steamers, all of which must come up to specified tests as to speed and adaptability to government uses in war. Besides supplying the extra vessels needed, this plan would be a means of opening new trade with South America, Africa, etc.

(3) Subsidy to cargo vessels and deep-sea fishermen to equalize the running expenses of that class of vessels. The number of months that a vessel has been in service is the basis on which the following subsidy should be granted:

Period of time in Service.	Subsidy Earned.
12 months of one year.....	$5.00 per registered ton.
9-12 months of one year.....	$4.00 per registered ton.
6- 9 months of one year.....	$2.50 per registered ton.

Any one vessel to receive only one of the above bounties, and to be at the disposal of the government (for a prescribed consideration) in case of war.

(4) Naval Volunteer Retainers.—Foreigners would flock to secure the superior American food and treatment, and then when the war clouds hung over the United States, would go back to their own government, and leave us with our pick of vessels, but without trained citizens to man them. Therefore, it is proposed that "naval volunteers" be required on each outward passage, and an increasing percentage of these as members and apprentices of each crew until at least 50 per cent are such men, such persons to receive from the government each year as compensation for willingness to serve in case of war a sum which varies from $100 for masters and chief engineers to $15 for boys.

These schemes will cost, and who will pay?

There is at present a tax imposed on the tonnage of any vessel for entering (except in distress) any port the world over. This is generally limited to the first few entries each year. In the United States the money thus derived ($862,840) goes into the nation's treasury to be spent for irrigation, or Indian reservation, or other lay purposes. Postmaster-General Meyer, in January, 1908, directs our attention to the fact that the net profit from the ocean-mail service in the last fiscal year was $3,637,226.81.

In all fairness, incomes thus obtained should be used to aid the struggling industry under consideration; and, as the tonnage dues of the United States are the lowest in the world, as a partial offset to the proposed expense an advance of 10 cents per registered ton is suggested for each arrival of any vessel from nearby foreign ports, not to exceed $1 per ton in any one year, and 20 cents per registered ton for each arrival from a distant foreign port, not to exceed $2 per ton for any one year. The net profit on ocean mail should revert to the fund.

In 1905 there were only 92,786 gross tons built on the seaboard, not over 25,000 tons were designed or even could be used.

The naval volunteer idea being entirely new in America, it is probable that not more than 3,000 men would be enrolled the first year; that there would be a total enrollment of 6,000 the second year, 8,000 the third year, and 10,000 the fourth, which would presumably exhaust the available supply of material, based on Great Britain's example. In round numbers, there would be an average profit of $4,000,000 a year from the ocean mail service, and this would increase as better service was offered; and the tonnage tax would afford $4,500,000 per annum.

If the above plans were adopted, the American people would make a profit, secure lower freight rates, and secure following beneficial results:

1. Ten thousand naval volunteers available in case of war. 2. A new fleet of from 200,000 to 300,000 tons of steel mail steamships, and a naval reserve needed by the country as shown by the report of Admiral Dewey. 3. A net addition of our cargo and fishery tonnage of 5,300,000 tons, increasing fourfold the actual ocean shipping of the United States, and enabling us to carry not 10 per cent, but 30 per cent or 40 per cent of our own exports and imports. 4. The creation of ten regular new or strengthened steamship lines, creating new outlets for American products. The burden of this would be borne in a large part by the foreign ships which have disintegrated and now monopolize the American merchant marine.

A NEW PROCESS IN MILLING.

A new process in milling, by which the phosphates and other essential mineral salts are retained and a good merchantable white flour produced, has been devised by Mr. F. C. Ireland, a food expert.

The flour produced by this new system of milling is uniform in quality, whether made from old or new wheat. The bakery shows a yield of 20 per cent more bread and of a more nutty flavor and certainly of greater hygienic value than bread made of any flour under the old system. In this new system no chemicals whatever are used in the process. The flour has a slight yellowish color owing to the retention of the phosphates and other mineral salts, which are all or nearly all refined out of the white flour by the system now in use.

In this new flour the starch, gluten, nitrogen, carbon, calcium, sulphur, sodium, iron, potassium, and magnesium are retained. All these essential constituents, found naturally in the wheat, are so consolidated together and in such a manner that the very best refining machinery, while useful in removing the bran, which is a substance of straw, cannot remove the mineral salts mentioned. They are left in the flour, no matter how fine it is made.

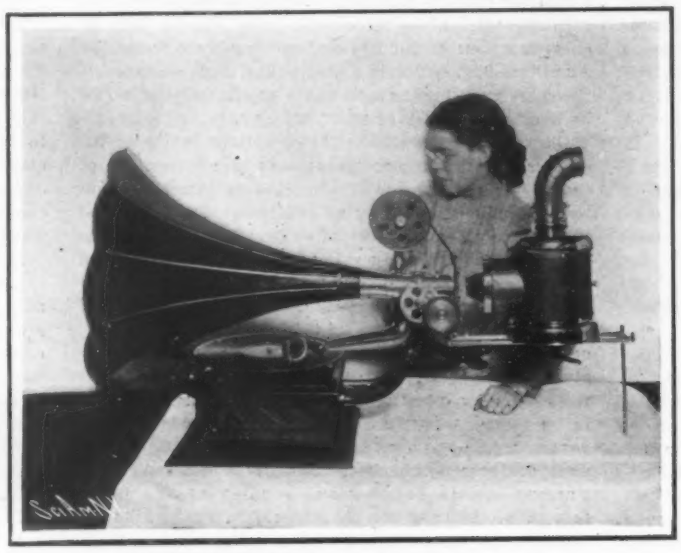
Helium Not Solidified.

Prof. Dewar, who recently made the announcement that helium had been solidified by Prof. Ohnes, of Leyden, now admits that a mistake has been made. Prof. Ohnes discovered that his helium contained a slight admixture of hydrogen which accounted for the solidification.

When the oxides of nitrogen have been separated from the mixture which is formed by electrical discharge in air, it is important to cool the mixture of the gases in order that dissociation may be avoided. To do this H. Pauling, in a recent American patent, proposes to effect the cooling by introducing an already cooled mixture of the gases into the hot gases, instead of using an inert gas for this purpose.

COMBINED MUTOSCOPE AND TALKING MACHINE.

There are certain inventions of so common-sense a character that they immediately suggest the question, Why was not that thought of before? There is a natural relationship between phonographs or kindred machines and moving picture apparatus, since they both give a reproduction of life, though appealing to different senses. What could be more logical than to combine the two machines so that one would complement the other? This has just been done by Mr. L. P. Valiquet, of Newark, N. J., in the manner shown in our engraving. It is Mr. Valiquet's opinion that phonographs have about reached the acme of their popularity and many are beginning to tire of them, and that by adding the mutoscope feature there will be a revival of interest in the instruments and their popularity will receive a new boom. With this in view he has so designed the apparatus that the mutoscope attachment may be fitted to any standard phonograph either of the disk or of the cylinder type.



A COMBINED MUTOSCOPE AND TALKING MACHINE.

Our illustration shows a disk machine fitted with the moving picture attachment. The pictures are projected through the horn of the instrument. The usual elbow to which the horn is applied is removed and in its place a tubular tee is provided. In the forward end of this member the horn is secured. The member is also provided with the mechanism for operating the reel of pictures. The film is coiled up on a reel mounted above the tee tube and passes over the rear end of the tee to a take-up reel below. The film is moved past the end of the tee by operating a hand crank which actuates the necessary gearing to multiply the speed of travel. The gearing also actuates a shutter which vibrates up and down so as to interrupt the exposures in the usual manner. The lantern is mounted on a pair of horizontal bars which project to the rear and are supported at the extreme rear end on an adjustable vertical standard. Either gas or electricity may be used to furnish the light. It will be noted that the talking machine is unchanged with the exception that the elbow is replaced by the tee tube. The instrument thus combined is called a "photophone" and should furnish much entertainment, as the audience, whether in the home on in a public hall, will be able to see and hear at the same time a comic performance, operatic production, and the like. We are informed that a large number of special films and records have been prepared with a special view to providing an entertaining combination of music or conversation with moving pictures.

The cylinder machine is similar in most respects to the disk machine, with the exception that a flexible connection is provided between the horn and the stylus so that the horn may remain stationary while the stylus travels from end to end of the cylinder.

A SIMPLE APPARATUS FOR GENERATING HYDROGEN.

BY PROF. GUSTAVE MICHAUD, COSTA RICA STATE COLLEGE.

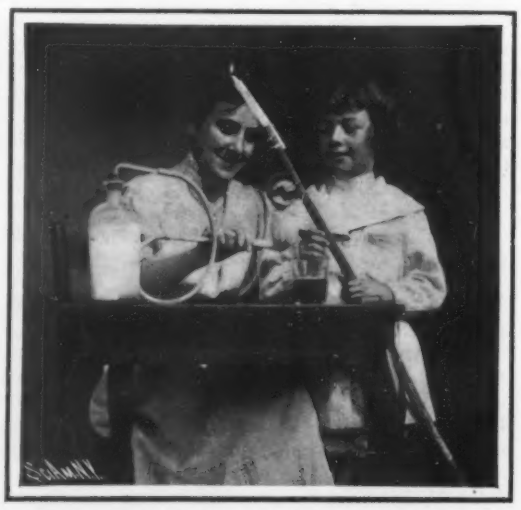
Broken pieces of aluminium table or kitchen ware can be used for several interesting chemical experiments. The following is a simple one: Buy from a druggist a foot or two of rubber tubing, a stopper with a small glass tube running through it and a few ounces of caustic potash or soda. Select a bottle to match the stopper and in it place the broken pieces of aluminium. Pour over them some lukewarm water and add a few spoonfuls of caustic soda. (This chemical is not so dangerous to handle as sulphuric acid, yet contact with the skin should be carefully avoided.) An effervescence will at once take place and will last for several hours in spite of the fact that the liquid is no longer lukewarm.

Hydrogen gas will be generated, escaping through the rubber tube, and the gas may be used for any of the experiments described in books on chemistry. It should not be ignited directly at the end of the tube unless fully a quarter of an hour has elapsed after the beginning of the effervescence. *Disregard of this caution might cause an explosion on account of the oxygen left in the bottle.*

A given weight of aluminium displaces almost four times as much hydrogen as is evolved by the same weight of zinc, and some day, therefore, aluminium will be used instead of zinc for the industrial preparation of hydrogen. The method is at present more expensive than the ordinary zinc-and-acid process, yet it should be given the preference in several cases on account of the following two points of superiority:

1. The gas is free from hydrogen arsenide, hydrogen sulphide, and acid vapors. Its greater purity becomes especially apparent when it is used to inflate soap bubbles. With the classical apparatus the experiment cannot be made unless the gas is purified after leaving the bottle, because the acid vapors it carries along break the bubbles long before they reach any considerable size.

2. The apparatus is simpler and the operation easier than in the case of the zinc-and-acid process. There is no need of a Wolff bottle with a contrivance for the gradual addition of small amounts of one of the reagents. All the needed alkali is placed in the bottle at the outset, and the gas is generated continuously and regularly until the last bit of aluminium has disappeared.



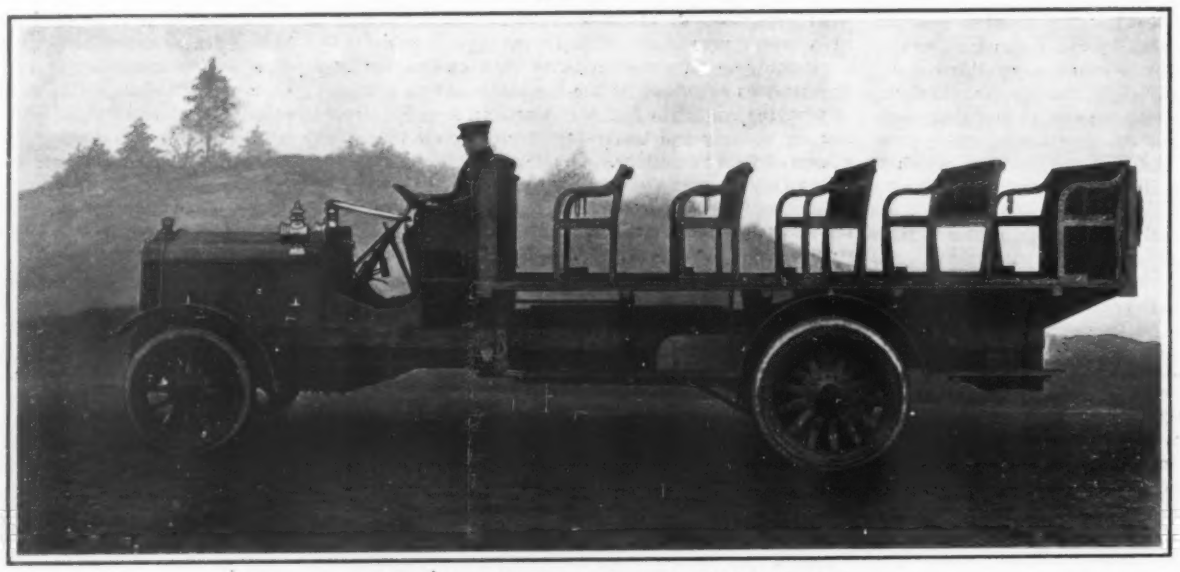
A SIMPLE APPARATUS FOR GENERATING HYDROGEN.

CONVERTIBLE MILITARY TRANSPORT MOTOR WAGON.

BY OUR ENGLISH CORRESPONDENT.

The vehicle pictured in the accompanying engraving is expressly designed for military purposes for the transport of troops, or for the conveyance of baggage, stores, ammunition, etc. The conversion from one type to the other is effected in a few seconds, and if so desired, one-half of the wagon can be arranged to accommodate passengers, the other half being available for freight. The most important feature of the design is that no extra parts are required to convert it from one type of vehicle to the other. The seats are so arranged transversely that the passengers all face in the direction in which the car is traveling. Steel standards are fixed at each side, and on these the seats rest, the latter being made in two parts hinged together, one part forming a back rest, while when used as a baggage wagon, these standards serve as supports to the sides.

When it is desired to convert the vehicle from a passenger into a baggage wagon, the seats, which are portable, are lifted out and used to build up the sides of the vehicle. The necessary fastenings for securing the sides are already fitted, so that the complete change can be effected within two minutes. An important feature in the designing is that the seats are exactly half the length of the space which is required to be filled so as to change from passenger to baggage wagon. The seats have an over-all width of 15½ inches, with a similar clear space between each. Five rows of seats are available when the wagon is exclusively used for passenger purposes, and this provides accommodation for twenty-five men. Suitable clips are provided on the back of each seat for the housing of rifles.



A CONVERTIBLE MILITARY TRANSPORT MOTOR WAGON.

The vehicle will accommodate 25 men, or it may be converted into a baggage wagon.

The vehicle has an over-all length of 21 feet 3 inches and is driven by a four-cylinder 32-horse-power gasoline motor. The over-all width is 6 feet 9 inches, while the top of the sides is 6 feet 9 inches above the ground. At the rear beneath the floor there is a toolbox, and a locker in which 6,000 rounds of rifle ammunition can be carried is also provided. Ringbolts are provided to permit of securing heavy and cumbersome piles of baggage with ropes if found necessary, and there are also two eyebolts large enough to take block and tackle. When used as a composite passenger and baggage vehicle, the seating accommodation comprises two rows of seats, the latter half of the car, 6½ feet in length, being used for stowing the baggage.

The commanding officer's seat is placed beside the driver, who is thus conveniently near for carrying out driving instructions, while to the dashboard is fitted a folding table for the use of the officer, who may desire to consult maps, etc., while in transit.

The convenient and handy nature of this car has recently been demonstrated. One of the volunteer battalions upon the Tyneside has acquired one of these vehicles and has found it highly serviceable for certain phases of military operations. Owing to its substantial construction, it is well adapted to the rigors of military service, though it is equally applicable to ordinary freight traffic. The vehicle was designed by Sir W. G. Armstrong, Whitworth & Company, the well-known British armament manufacturers.

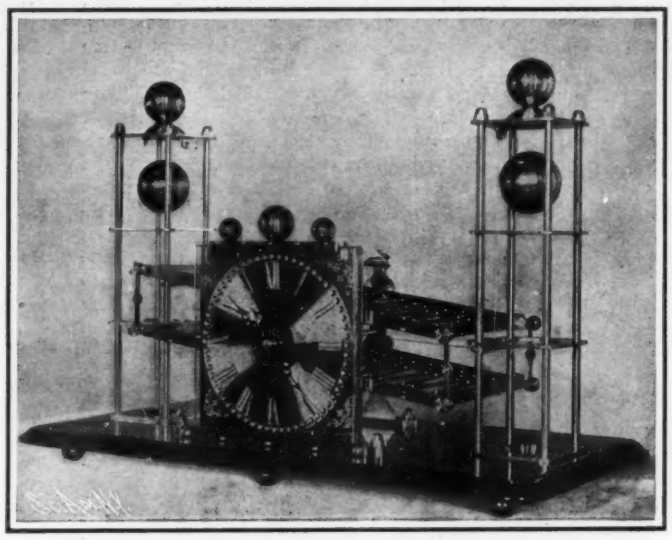
Getting broken taps out, says a writer in the American Machinist, is, in one shop at least, performed by pouring hydrochloric acid into the hole. The acid is left there for about four minutes and enough of the tap and the hole is eaten away to loosen the tap.

A CLOCK WITH A SINGLE WHEEL.

BY R. NEWTON.

A unique product of mechanical and horological genius is illustrated herewith. Were it not for the familiar-looking dial, there are few persons indeed who would take this object to be a clock. This wonderful timepiece, which was constructed by C. H. Brigden, a watchmaker of Los Angeles, Cal., has been made to keep time with a single wheel only. This wheel is really no wheel at all, but rather a perforated disk which serves as an escape wheel.

The escape wheel is kept under rotary tension by two weights, very much like the escape wheel of a large clock. In place of a pendulum and gearing, 31 quarter-inch steel balls are used, which operate consecutively. When the timepiece is set, one of the metal balls is caused to descend, in zigzag fashion, on two pivoted plates, one located above the other. After the ball has descended to the lower plate, its course is directed in such a way that it enters one of the holes at the lower end of the perforated disk, releasing the disk and then proceeding in its rotary motion the space of one hole. As the time consumed by such an operation is limited to one minute, it follows that the disk must be pierced with 60 holes for one hour's time. The forward motion and stopping is effected by the unlocking and locking of a spring, the former part of which may be done by the percussion of the descending ball. As the perforated disk carries 30 balls on one-half its diameter, the addition of the 31st ball will change the perpendicular position of ball number one, and cause it to roll out onto the upper pivot plate. It will then repeat its original operation.



A CLOCK WITH NO GEAR WHEELS.

THE EXPLORATIONS OF THE GERMAN ORIENT SOCIETY.

BY DR. ALFRED GRADENWITZ.

Though our age is mainly characterized by a keen industrial activity, and a rapid advance of such doctrines as are apt to improve our standard of life, it by no means disregards the painstaking work of the archæologist, intent upon penetrating the spirit of bygone civilizations. On the contrary, we are safe in stating that those studies have never progressed so rapidly as in the last few decades, owing especially to the systematic excavation work carried out by the leading nations. As a result of these endeavors, the ideas so far held with regard to the relative importance of ancient civilizations would seem to be on the eve of a complete revolution, archæologists realizing more and more that the originality and importance of Grecian civilization, being mainly based on the far more grandiose Egyptian and Babylonian (and generally Semitic) civilizations, has been greatly overrated. If certain aspects of our modern civilization appear rather petty, as compared with the grandeur of Græco-Roman culture, the more ancient civilizations from which this has arisen, in their turn eclipse it by their incomparably greater majesty.

The interest of archæologists obviously centers round the African Orient and Western Asia, which is the cradle of humanity and its civilization. As private initiative is unable to cope with the political and financial difficulties besetting their work, the leading nations have organized special societies under the auspices of their respective governments and sovereigns. The German Orient Society, founded just ten years ago, under the patronage of the Emperor, and which boasts among its members the foremost scientists, as well as leaders of society, has been successful in contributing to a large extent to our ever-increasing knowledge of ancient civilization. Mesopotamia, the old Two River Land, situated in the valleys of the Euphrates and Tigris, forms the main center of the work of the society. The city of Babylon, with its walls and canals, and the royal citadel of Nebuchadnezzar and Nabopolassar his father have now been excavated almost entirely. Esagila, the national sanctuary of the Babylonians of old—the temple of Marduk, their supreme deity—has been restored to light, as well as the majestic double gates of the goddess Ishtar. After having been hidden by the earth for thousands of years, the towers of the gate now again rise to a height of 40 feet, and the reliefs of bulls and dragons decorating its walls, with variegated enamel tiles, still give an idea of the ancient splendor of its colors. It is mainly due to the indefatigable work of Prof. Koldeway, who for about ten years has lent the society his valuable assistance, that the complicated and extensive plans of this giant city, which had been so long the ruler of the world, will soon be reconstructed in their entirety.

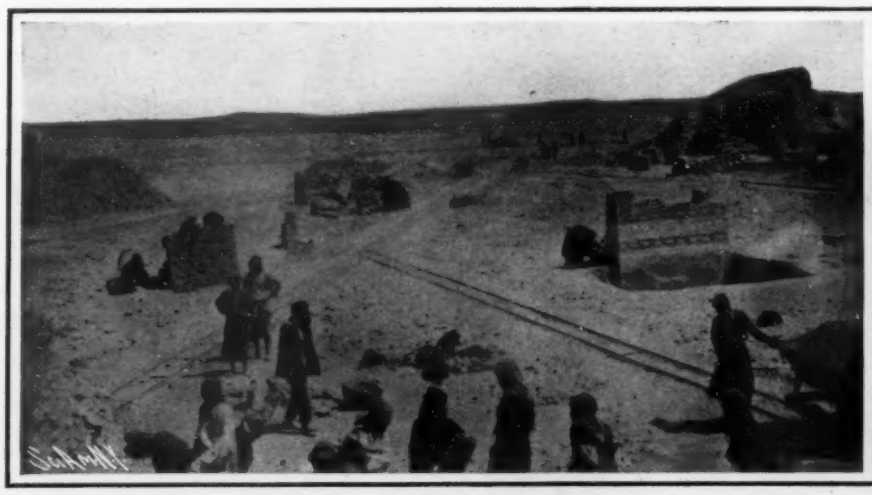
Vase From the Temple of King Sahure.

The headquarters of German excavation work in Babylon, in spite of its isolated situation, far from all European civilization, have been fitted up with relative luxury and comfort. The society has further done successful work on the site of ancient Assur. The palaces of Salmanassar I. (about 1300 years before Christ), Tiglath-Pilesar I. (about 1100 B. C.), and Assurnazirpal (900 B. C.), the temple of Assur, the uppermost Assyrian god, with its lofty tower (the Zikkurrat), have been laid bare with their foundations. The city walls, 23 feet in thickness, protected by a quay on the bank of the Tigris, with their vaulted sallyports and well-preserved ramparts, have again been brought to light from the surrounding debris. An enormous city gate has been found, with powerful double doors, situated one behind another, the six heavy basalt angle stones of which are still situated at the old place. Of special interest are the sepulchers, found in the middle of the city, and which are partly intact. They show that inhumation and incineration were practised side by side in late Assur. A number of private houses further give an insight for the first time into the arrangement and inner appointment of Assyrian dwellings.

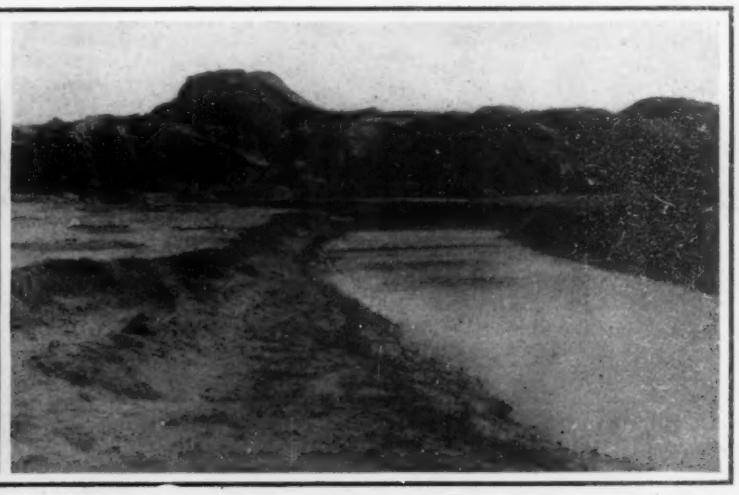
In connection with the Mesopotamian excavation work, the German Orient Society has carried out successful researches of a similar kind in Palestine, viz., at Tell-el-Mutesellim (which, probably, is Megiddo of old), where in conjunction with the German Palestine Company, the city walls with their gates and a number of sepulchers have been uncovered; and in ancient Galilee, where a dozen synagogues were searched, especially at Tell-hum, the ruins of the well-known Biblical place of Capernaum. An expedition has recently set out to excavate ancient Jericho.

The first remarkable find made in the ruins of Babylon was a stele, bearing Hittite inscriptions, and which, as it were, presaged some even more important discoveries lying in store for the Orient Society. In fact, the latter only quite recently, in conjunction with the excavation work of the Ottoman Museum at Constantinople, succeeded in laying bare the capital of the once powerful Hittite realm in the center of Asia Minor, and the unexpected discovery of an archive comprising thousands of clay tablets, with cuneiform inscriptions from the thirteenth century B. C., justly amazed and startled the scentific world.

Egypt was very early the scene of similar work at the hands of the German Orient Society. At Abusir a number of sepulchral pyramids and mortuary temples of several rulers of what is called the Old Kingdom (about 2500 B. C.) have been discovered, giving for the first time a clear idea of royal sepulchers at that early epoch of Egyptian history. Their reliefs may be counted among the finest productions of the Egyptian art of those times. Numerous columns, partly in an excellent state of preservation, have been found in temples, and richly-gilded vases adorned with blue faience incrustations, which were used in connection with the cult of the dead kings, afford a rare pleasure even to our over-sated eyes. At Abusir-el-Meleq, at the entrance to the Fajum, there has been discovered an extensive prehistoric cemetery (of about 3500 B. C.), the tombs of which, with their numerous offerings, are of the highest importance to the history of the earliest Egyptian decorative art. A trial search, made at Tell-Amarna, would seem to be of very good



Double Gates of the Goddess Ishtar.



Excavations at the Assur Citadel.

THE EXPLORATIONS OF THE GERMAN ORIENT SOCIETY.

augury for the future, being likely to result in the complete excavation of the city of Amenhotep IV., the Egyptian "heretic king," whose reign was possibly the most remarkable epoch in the history of the ancient Orient.

An extremely interesting find, recently made in Lower Egypt, is a papyrus bearing Aramaic inscriptions in cuneiform and Semitic characters, according to which a prosperous Jewish colony was in existence as far back as five centuries B. C. The most remarkable fact borne out by those inscriptions (which have been deciphered by Prof. Sachau) is that a Jehovah temple, in which every detail of the Biblical cult was performed, existed in that country simultaneously with the second temple of Jerusalem. This, apart from the existence of numberless synagogues scattered throughout the civilized world of those times, is an excellent argument against certain modern critics of Judaism, who would fain abase it to a narrow-minded local cult, devoid of any universal ideas.

Apart from the excavation work proper, the German Orient Society has set itself the task of making its results more widely known, by issuing to its members four to six illustrated reports per annum, and by arranging a limited number of scientific publications intended to reach those interested in archæology.

Screen Plate Color Photography.*

In order that any method of color photography may be clearly understood, it is necessary first to consider the basis upon which color photography has been developed. That basis is that any color might be matched by a mixture of light of three different colors, those colors being chosen correctly as regards their spectrum composition, and then being adjustable in intensity until the color is matched. This effect is an experimental one, and independent of any theory of vision. If three isolated patches of the spectrum be taken, an orange red, a blue violet, and a pure green, then by mixing these three isolated patches, any of the primary or secondary colors may be matched, the only colors which cannot be matched being the pure colors outside the range, namely, pure monochrome violet, which is so dark that blue violet would match it quite satisfactorily, and pure deep spectrum red to which the nearest match which can be obtained is orange red degraded by black. In fact, pure deep spectrum red is the only color which could not be sufficiently well matched by this method. Forty years ago Ducos du Hauron suggested the production of a screen plate as forming a simple method of color photography, which was to consist of a sheet of transparent paper mechanically covered upon its surface with three kinds of colored stripes or divisions. Writing of this method, du Hauron said: "Let us imagine that one covers the surface of the paper on the side where the color stripes are imprinted with a preparation which gives directly, under the influence of light, a positive proof, and that one receives on its reversed side—namely, on the side not covered with stripes—the image of the camera. It will happen that the three single colors will filter through the paper and form each its positive print, i. e., its print in light of the corresponding ray of color, and the three prints will be formed with the same rapidity, in spite of the unequal degrees of actinism of the three simple colors, if one has been careful to give to each of these three sorts of stripes a relative translucency, inversely as the photogenic power of these same colors on the preparation employed.'" That was in 1868, and it formed the basis of the screen plate processes, the first of which was put forward commercially in 1895, when Prof. Joly invented his system of screen plate photography. Prof. Joly ruled on gelatine-coated glass sets of three lines, and placed the screen so prepared in contact with the sensitive plate. After exposure the plate was developed and the positive made; it was then again placed in contact with the screen, the result being a most satisfactory image in colors. The real difficulty of the Joly process appeared to have been the difficulty of obtaining plates which should be regularly of the same sensitiveness. The compensating screen which fitted one batch of plates would not fit another, and that difficulty was felt to be a grave objection to the general application of the process.

Somewhat previously to Prof. Joly's method, Macdonough had prepared plates by scattering over their surface small flakes of colored shellac, and then fusing these flakes on to the surface; but Macdonough was convinced of the superiority of the line method, possibly because of registration difficulties, and he endeavored to produce screens by machinery in large quantities. The plates were ruled with fine lines by means of celluloid wheels which deposited colored inks on the surface, but the process was very difficult and the plates were extremely costly to make.

Another process, one which is said to be nearly ready, is that invented by Robert Krayne. Sheets of celluloid are stained in the requisite colors, and are then placed on the top of each other and cemented together so as to form a continuous block of red, green, and blue celluloid. A section is then cut straight through this block, and a leaf obtained which shows throughout its width the red, green, and blue lines which were originally the leaves forming the block. To make the Krayne mosaic screen, these lined screens are again cemented together to form a block, and a section is now cut at right angles to the line direction. The colors of the Krayne plates which the lecturer had seen were very good, but it is difficult to get the line sufficiently fine. It involves the cutting of extremely thin celluloid sections; and it must be remembered that the narrower the lines became, the finer must be the celluloid; otherwise the parallax error due to the thickness of the line would be appreciable, and it would probably be necessary to support the film on glass if it became so thin. Also, if the line is to be made very thin, it would be necessary to dye the celluloid very deeply, in order that the colors might be of the requisite intensity. I have coated a sheet of glass with bichromated gelatine on the ordinary coating machine, and then exposed this glass under a lined screen having the black lines one-half the width of the spaces. In this way two-thirds of the width of the screen became hardened, the lines covered by the black screen line remaining soft. This soft line was then dyed up with one of the many dyes which do not penetrate hard gelatine, and, after drying, the plate was again coated with bichromated gelatine, and the second and third lines were put on in the same way. This method of manufacture is quite simple with coarse lines, such as are necessary for illustrative purposes, about 15 to the inch, but I doubt if it would be commercially practical for small units. It does not follow that the method which comes to the fore is easiest of production, or the one calculated to give the best results. Either of those things might be true or might not. In order that a process might be commercially introduced, there is required not only the primary idea, but a great deal of patient working out, and probably a manufacturing house behind it. Because in the end the production of anything of that sort is a question of commercial scale working, and only a factory could experiment on a sufficiently large scale.

Regarding light filters, by using an inclosed arc (barium being introduced into the arc to produce a line spectrum) focused on the condenser of a microscope with a 1/10th inch objective, and then a micro-spectroscope attached to a camera, it is possible to obtain spectrographs of the absorptions of the Lumière and the Warner-Powrie filters. But there is another method of doing this which is quite as satisfactory and very much less trouble. Fitted in front of the spectroscope a small black wedge which will give a gradation of light along the slit, the variation in intensity running from 1 to 10,000, and consequently spectrophotographs in this spectroscope show a scheme of hills and valleys, the summits representing the maxima of sensitiveness and the valleys the minima. In regard to obtaining positives, an obvious method of using screen plates is to make a complementary negative, and then to print a positive through a second screen; but if this were done, it would be found that the colors are quite faint, being degraded by grays. With regard to the whole use of screen plates, one is bound to feel that interesting as they were, and marvelous as has been the ingenuity shown in the production of autochrome plate, yet at the present time their application must be limited. No color process which can not be printed on paper can hope to appeal to the great mass of workers. And if the plates are used as transparencies, either in the hand or in the lantern, the density caused by the presence of the screen is so great that a special view apparatus is desirable, a very great drawback indeed to the plates. What screen plates need, in fact, as their complement is a printing process such as some improved bleaching-out emulsion, which could be placed on paper and on which the plates could be printed. In the meantime screen plates, and especially the plate which alone can be obtained at the present time, must surely form the most fascinating toy as well as the most useful instrument which photography has to offer.

* From an address by Dr. C. E. Kenneth Mees, D.Sc., before the London Society of Arts. An important historical article on the history of color photography appears in the current issue of the Supplement.

Aeronautical Notes.

A trial flight was made on April 17 by Army Balloon No. 10, carrying Lieut. D. S. Lang of the Signal Service Bureau, Captain Van Horn of the President's staff, Lieutenant Thomas Selfridge, and R. A. Collins, a newspaper correspondent. The start was made from Washington, D. C., at 2:17 P. M. The intention of the aeronauts was to fly to the south of the city, but the balloon went in the opposite direction, passing over Montgomery and Howard Counties, and attaining a height of 7,000 feet when above Ellicott City. Here a change in course took place, the balloon drifting eastward across Anne Arundel County, the Patapsco River and Spring Gardens, whence it passed over Baltimore. It dropped to an elevation of but 600 feet and the aeronauts, despite their efforts to remain aloft by throwing out ballast, finally landed on a private estate in the northern suburbs at 6:15 P. M.

The new company for the manufacture of dirigible balloons, which has recently been formed in France, has undertaken the construction of a dirigible of the type built and experimented with by Count de la Vaulx a year or so ago. This company has an aerostatic park and shed at Saint-Cyr, just back of the park of Versailles. Count de la Vaulx is the director of experiments, and he expects shortly to have several dirigibles ready for test. In Germany the Berlin Motor Airship Company is having a new dirigible built by Riedinger, of Augsburg, after the plans of Major von Parseval. It is expected that this airship will be completed in May. The new dirigible is of about the same size as the former Parseval airship. The military authorities have established an aerostatic park at Metz. The first airship to be located there will be one of 70,629 cubic feet capacity, which is being constructed after the designs of Major Gross.

In addition to the aviation prizes tabulated in a recent issue of the Scientific American, there have been several other prizes recently offered. The chief of these (which, however, is only offered to German aviators, whose machines have been built and experimented with in that country) is the sum of $10,000 given by Herr Karl Lanz of Mannheim. This generous merchant has also offered $2,500, to be used in aiding poor inventors in the construction of their flying machines. His example is one which should be followed by wealthy men in this country, in order to hasten the development of the new science. Other prizes are $5,000 offered by the Municipal Council of Dieppe, France, for aeroplane races to be held at that place during the second week of July; $500 offered by M. Montefiore for the longest flight before July 1; $1,000 offered by the Aviation Commission of the Aero Club of France for the longest flight before October 1; and $250 or more (the prize being raised by subscriptions) for the first machine to fly over a line 25 meters high in the presence of the Aviation Commission of the Aero Club of France. The Michelin prize of $3,000 annually for ten years has been changed to $4,000 annually for eight years, and the distance which must be flown the first year has been raised to 12 kilometers (about 7½ miles). As M. Delagrange has already flown about 4½ miles on the 11th instant, it seems probable that the winner of this prize in 1908 will be obliged to make a flight of a considerable distance. The flight must be in a closed circuit, and must be held under the direction of the Aero Club of America if made in this country.

An effort is being made by several leading aeronautic experts in this country, including Alexander Graham Bell, Octave Chanute, and A. Lawrence Rotch, to obtain a fund of $25,000 to be given as prizes for aeroplane flights by Americans. It is hoped to raise the money before August 1, and to then turn over the fund to the leading aero club of the country, or to some scientific institution of national standing. The club or other organization will frame the rules and conduct the contests. In this way it is hoped that experimentation will be encouraged, and that the leading aviators of this country will come forward and demonstrate what their machines are capable of doing. Subscriptions to this fund can be made conditionally upon the raising of the entire amount. Such subscriptions need not be paid before August 1. All desiring to subscribe should signify their intention by writing to Mr. James Means, Box 167, Back Bay Post Office, Boston, Mass.

The Current Supplement.

The question of coast erosion is a very serious one in England. The city of Brighton has suffered much in the past; for the large chalk cliffs, which rise to a height of about 120 feet on the Brighton coast, have from time to time crumbled in heavy storms. J. B Van Brussel in an article entitled "Groynes of Reinforced Concrete to Check Coast Erosion," describes efforts which are being made to prevent these ravages. After five months of continuous labor, the unanimous report of the commission of inquiry on the Quebec Bridge disaster was presented to the Canadian Parliament on March 9. We present in the Supplement an outline of the investigations and a summary of the conclusions reached by the commission. The introduction of high-speed steel for machine tools has called for stronger drills to sustain the increased feed and speeds. How one Chicago company has met this need by the introduction of a novel 16-spindle drill is described. G. Chalmarés contributes an article on a constant-level gas meter. Chapman Jones, the well-known English authority on photography, gives a very complete review of the various efforts which have been made in the past to make photographs in colors. In an article entitled "Farming the Kangaroo" Harold J. Shepstone describes a novel experiment which has proved successful in England. Jacob B. Brown contributes a very interesting article on eclipses, in which he shows how they are calculated.

Correspondence.

Concrete Dwellings Built in Sections.

To the Editor of the SCIENTIFIC AMERICAN:

Permit me to call to your attention a system of constructing concrete dwelling houses in section which to some may seem inspired by Mr. Edison's plan, but which was in reality conceived long before his scheme of casting houses was made public.

One of the principal features of my system is the wall construction, which consists of upright pillars, columns, or plates formed of concrete (monoliths) reaching from the base upon which the floor rests to the ceiling or support of the second story or roof. These monoliths or units are cast in molds and when placed in the building match to form the walls of the house. Provision is made for doors, windows, bay windows, to suit the views of the owner, the monoliths lending themselves and matching in various ways. These monoliths are peculiar in form, each being composed of an exterior wall and an abutment member in one piece, the abutment member being of sufficient depth to insure stability. The wall member therefore may be comparatively thin. The aggregate amount of material used for this construction is considerably less than when the ordinary concrete blocks or any other concrete form is used. The monoliths are connected on the top by molded slabs or plates that fit over the form of the ends of the monoliths. These plates project beyond the face of the wall, if desired, forming a dripping shelf, or an ornamental, horizontal band. The inner edge of these plates forms a molded cornice inside the room, in a line with the faces of the abutments; these plates, extending entirely around the walls of the house and projecting into the house, form the base for the support of the floor slabs. The floor slabs are reinforced and can be supported by reinforced concrete girders or beams, the floor slabs forming the ceiling of the room and the floor of the story above.

In a one-story house, roof slabs with provision for shedding water are used in place of floor slabs, and the walls extend up and are finished off by special concrete in the form of parapet or balustrade. A second story can be added using the same style of monoliths, fitting and resting on the plates.

These wall, floor, and roof slabs and plates are of such size, form, and weight that two or three men can handle and place them. They can be made where the material is accessible and cheap and transported like lumber to the building site and set up dry and tight in a few days. Building can be done in sections and more rooms or stories can be added as convenient.

This construction gives other valuable features. The spaces between the abutments all around form closets deep or shallow, dead-air spaces, flues, etc., by closing these spaces with doors or plaster board. Piping and wiring are easily provided for and always accessible.

The inside finish of the rooms will mostly be by doors of standard sizes and wooden panels. The abundant air spaces all around and the inside finish, mostly of wood, make the house cold and heat proof to the largest degree, as well as handsome and inexpensive. The kitchen and dining room can have abundant closets, shelf room, and recesses for range, tubs, etc. The living room can have abundant shelf room and books let into the wall inclosed by sliding or swinging doors. The parlor can have dust-proof glass cases for the bric-a-brac. The chambers will have abundant closets for clothing convenient in width and depth and full height. The space occupied by the building is more thoroughly utilized than any other form or mode of construction. Heating and ventilating are provided for by the most efficient and economical method.

This construction is intended to provide a permanent, fireproof house for families where economy is important. The first cost is less than any other form of concrete structure. The cost of keeping the house from year to year will be less than any other form. The outer walls can be made of any tint and the cost of painting minimized. The roof will be tight and permanent. There is absolutely no waste room. The greatest amount of room space is obtained with the least material. The conveniences are far superior to any other construction that will compare with it in cost. There are numerous valuable features that attach themselves to this mode of construction, the detail of which cannot be mentioned in this article.

Brooklyn, N. Y. THOMAS HALL.

A number of cases of zinc poisoning on board men-of-war have been found to be due to the zinc slabs fitted in the ships' filter tanks.

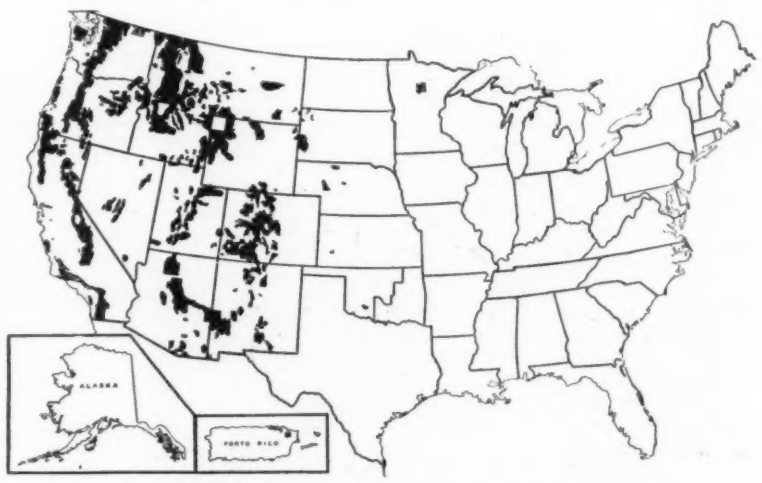
THE PRACTICAL WORK OF THE UNITED STATES BUREAU OF FORESTRY.

BY DAY ALLEN WILLEY.

Less than ten years ago the United States Bureau of Forestry began active operations, but in this period, limited as have been the facilities of the Bureau, it has accomplished such results that it may now be considered one of the most valuable divisions of the Department of Agriculture. Compared with the forest service of Europe, its facilities are indeed limited, for the total number of employees in the Bureau at the present time is less than 2,000, although it is caring for 166 national forests in the United States and its dependencies, embracing an area of no less than 162 million acres, representing over 250,000 square miles.

In the United States some of the individual forest rangers have an area of 200,000 acres of wilderness to care for. This means to guard against forest fires, the depredations of timbermen who would cut trees without authority, to preserve order among those who may be located upon the reserve, to supervise any grazing operations, in addition to performing other duties. Such is the extent of a field, that the ranger or guard may require a month or more to go from end to end of it, and during the journey must not only utilize his pony, but possibly a boat to navigate the lakes and rivers on the route. In these 166 forest reserves are actually less than 1,500 men of all ranks, and of the Bureau of Forestry less than 1,200 are forest rangers and guards.

The importance of the forest reserves from a commercial standpoint can be realized when it is stated that the government receives $1,500,000 in a single year from the use of land for grazing and from timber sold from the forests. It is a well-known fact that cattle are of much value in enriching poor and barren soil, so stock owners are given permits to turn their herds into the national forests, where pasturage can be obtained in sufficient abundance. Sheep are also allowed in regions where the undergrowth upon which they may feed is so thick and rank that they will aid in clearing it. This prevents the earth from being exhausted, and thus assists in the growth of the trees.



MAP SHOWING, IN BLACK, OUR NATIONAL FOREST RESERVES.

An important branch of the Bureau is devoted to wood chemistry, where tests are made of the value of certain timbers for such structures as buildings and bridges, also for paper pulp and distilled products from the wood. Practically all work is done in co-operation with persons or companies directly interested in the results. In co-operation with railroad companies, improved methods have been found of treating cross ties of Douglas fir, lodgepole pine, western yellow pine, red oak, loblolly pine, hemlock, tamarack, western larch, and western hemlock. Test railway tracks have been laid containing untreated ties and ties treated with various preservatives, in order to study their relative values under actual conditions of exposure. Different forms of metal and wooden tie plates have been employed with both screw and common spikes, in order to determine the most efficient rail fastening for softwood ties.

Since the Bureau of Forestry was organized, much attention has been given to the preserving of timber for telegraph poles. Test lines have been established, in which green, seasoned, and treated poles are placed successively to determine the lasting qualities of each sort through a period of years. The officials of the Bureau believe that much of the dead and fallen timber in the national forests may be made of value with the application of preservatives. Co-operative investigations have been carried on with cities to determine the kinds of woods suitable for paving blocks, and methods of treating them; experimental pavements have been laid, containing various kinds of wood treated in different ways. A study has been made of the timbers employed as piling in salt water, and the methods in use to protect them from the attack of marine wood borers. But perhaps the most valuable work of the organization is that associated with reforesting, the planting of forests on what formerly was desert land, and which now has been reclaimed for settlement by irrigation. The trees used in planting are grown at eight government nurseries in the following national forests: San Gabriel, Santa Barbara, Gila, Dismal River, Pike's Peak, Salt Lake, Pecos, and Lincoln. The combined area of seed beds at the eight stations is such that they now contain over 5,000,000 trees, from one to three years old. The seed sown in 1907 should produce not less than 4,000,000 trees, giving a total of over 9,000,000 in 1908.

The preliminary stage of forest planting within the national forests is now past, and several of the planting stations have produced trees of sufficient size to plant directly on the permanent site. About 700,000 trees were planted during the winter and spring of 1907, the greater part in the Dismal River, Niobrara, North Platte, San Gabriel, Santa Barbara, and Pike's Peak national forests. At the nursery in the Dismal River national forest more stock has reached an age suitable for planting than at the other stations. This nursery contains approximately 2,500,000 trees. At present there are about 1,000,000 trees for planting in the sandhills. The species largely in use up to this time are western yellow pine and jack pine. Other species, chiefly Scotch pine, Norway pine, and Douglas fir, are being tested in the nursery and in experimental plantations.

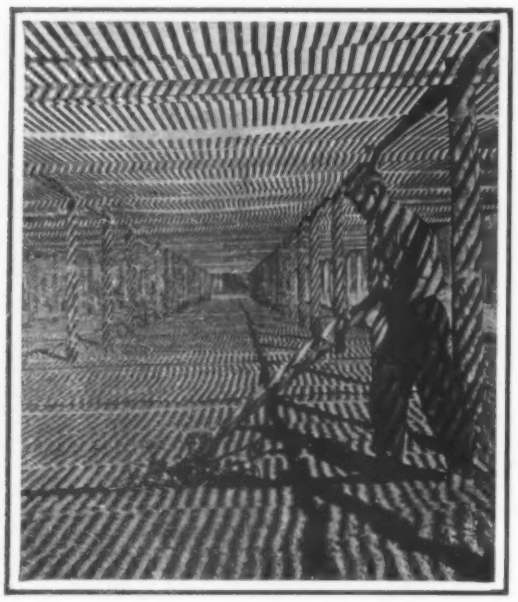
In 1906 plans were made for the establishment of small nurseries at rangers' headquarters in the national forests. Many nursery sites were selected, and the preliminary work has already been completed at some of these. The primary object was to train forest officers in nursery and planting work, and at the same time secure a considerable stock of seedlings for local use.

When we remember that no less than 200 million acres of arid lands may be adapted for agriculture by irrigation, and that already six million acres have thus far been reclaimed, it will be seen that the efforts of the Bureau of Forestry to create woodland tracts in what is now a treeless country are of the utmost importance. The forests are absolutely necessary for fuel. They are of value for shade, while they have a most important bearing upon any climate where they are located. In the tree nurseries and in the reforesting of denuded areas the most modern methods are employed, and the Bureau is assisted by a staff of able men, most of whom are graduates of forestry schools either in this country or Europe. The accompanying photographs give an idea of the methods employed.

The chief points in collecting seed are to collect mature cones, before the seed scales open, from large, well-formed trees; to open the cones by exposure to the sun, if possible; if not, by the use of artificial heat; to clean the seed by screening or winnowing; to store the seed in a cool, dry place, away from mice and rats. Comparatively level, deep, moderately fertile, well-drained soil is best for the nursery. At least one-half acre is set aside for a ranger nursery. Of this, much the larger part is required for transplant beds after the first or second year. A convenient size for seed beds is from 4 feet to 6 feet wide and 12 feet long. Paths 18 inches wide separate the beds. To insure drainage, the beds are raised from 2 to 3 inches above the surface of the ground.

The seed is sown either in shallow drills or broadcast on the beds. Drills are best, since the seedlings can be cultivated more easily. The drills are 6 inches apart, deep enough to cover the seed, and run across the beds. They are made by dragging a sharpened stick along one side of a 6-inch board. A still more rapid method is to nail triangular strips the desired distance apart on the underside of a board, and to mark the drills by pressing the board down on the bed. Sowing is ordinarily done in the spring, about the time early garden seed is planted. Immediately after planting, the beds are covered with a very thin mulch of clean leaves, moss, or needles. This keeps the surface moist and hastens germination. Water in limited quantities is applied to mulch beds. Practically all evergreen seedlings are transplanted to open nursery rows when one or two years old. Transplanting is done in the spring, when the soil is in good workable condition, but before new growth begins. Transplant beds are near the seed beds, and on good soil which has been prepared as thoroughly as for a garden. The usual width for transplant beds is 6 feet, with any convenient length. They are elevated slightly. The rows are 8 inches apart and run across the beds. The seedlings are set from 2 to 4 inches apart in the rows. In transplanting, great care is taken not to allow the roots of the seedlings to become dry, since even a short exposure to sun or air will be

fatal. After the seedlings have remained in the transplant beds one or two days, they are taken up and planted on permanent sites, chosen for their adaptability to the particular species grown.



Cultivating Young Trees in a Covered Nursery. The Striped Effect is Produced by Sunlight Falling Through the Slatted Structure.

Considering the results it has accomplished and is accomplishing, the Bureau of Forestry well deserves the mere pittance which it receives from the country in the annual appropriations. So far it has not had over $1,500,000 a year, upon which it must depend to carry on this work. Consequently, rigid economy must be practised in salaries and other expenditures. The supervisors receive from $1,500 to $3,000 a year, although this service requires a man who has not only had an extensive field experience, but must have scientific knowledge. The rangers, who may be called the forest guardians, receive from $900 to $1,500 a year, based upon the extent of their territory and the difficulty and number of their duties. Out of this sum must come the expenses of their horses and ponies, while they "find" themselves, the government merely furnishing them a cabin and a fence for the little pasture in which they may feed their stock. The guards, who are really assistants to the rangers, do not receive over $900 a year.

The benefits that this service may accomplish for the country, however, can only be realized by noting what has been done abroad. In Prussia, where forestry has perhaps reached the highest standard, the problem has been how to improve the forests in poor condition out of the returns from woodland which is in good condition. Since 1830 the cut of commercial timber has increased from only 20 cubic feet to the acre of forest to nearly 70 cubic feet at the present time.

In other words, by the forestry system the woodlands of Prussia have increased their production of timber products more than three times within seventy-five years, but the money value is in much greater proportion. The net returns to each acre of woodland at present are over $2.50, having increased tenfold within sixty years. The state forests of Saxony, which comprise about 450,000 acres, are in charge of a forestry bureau at a yearly expense which averages $3 for each acre; but such is the extent and value of the timber and other products, that the net yearly revenue averages $5.30 per acre after deducting all expenses. The appropriation of the United States for the Bureau of Forestry is so insignificant, that it amounts to a little less than one cent for each acre. Consequently, it is not strange that our revenue from this great natural resource is so small in contrast with that of European countries.

Experiments in Light Visibility.

The result of the experiments in light visibility conducted by Germany and the Netherlands working in harmony are given as follows: A light of 1 candle-power is plainly visible at one mile, and one of 3 candle-power at three miles. A 10-candle-power light was seen with a binocular at four miles, one of 29 at five miles, though faintly, and one of 33 candle-power at the same distance without difficulty. On an exceptionally clear night a white light of 3.2 candle-power could be distinguished at three miles, one of 5.6 at four and one of 17.2 at five miles. The experiments were made with green lights, but red lights of the same intensity can be seen at greater distances.

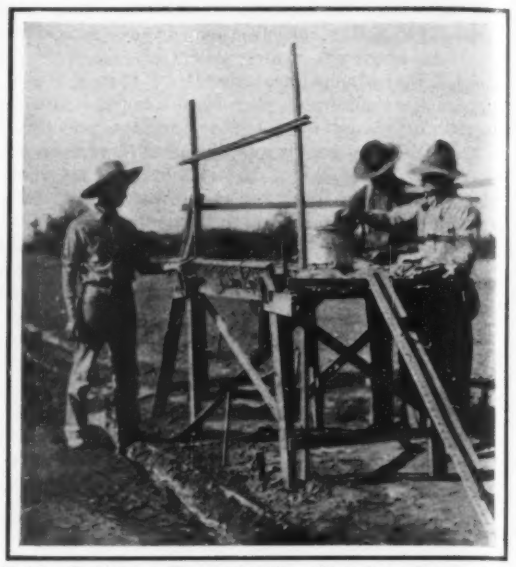
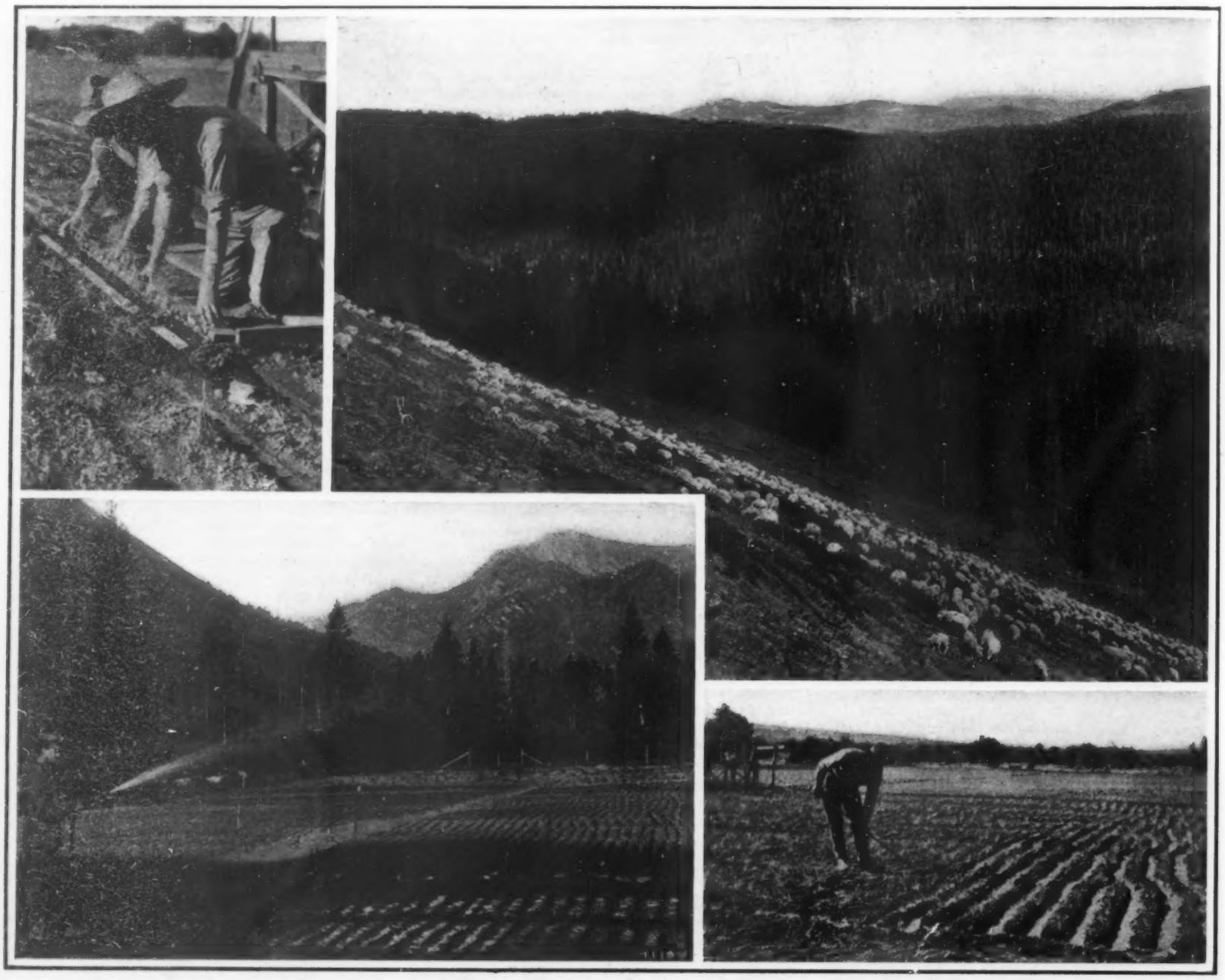


Table Holding a Transplanting Board on Each Side, the Nearer One Filled With Trees.

The Plants in Position With the Transplanting Board About to be Removed.

Sheep Grazing in the National Forest on Undergrowth Which Checks the Spread of the Trees, Thus Removing a Menace to Forest Growth.



Watering Young Trees on Reserved Plantations in One of the Utah National Forests.

Irrigating Transplant Nursery Beds by Running Water Between Rows 10 Inches Apart.

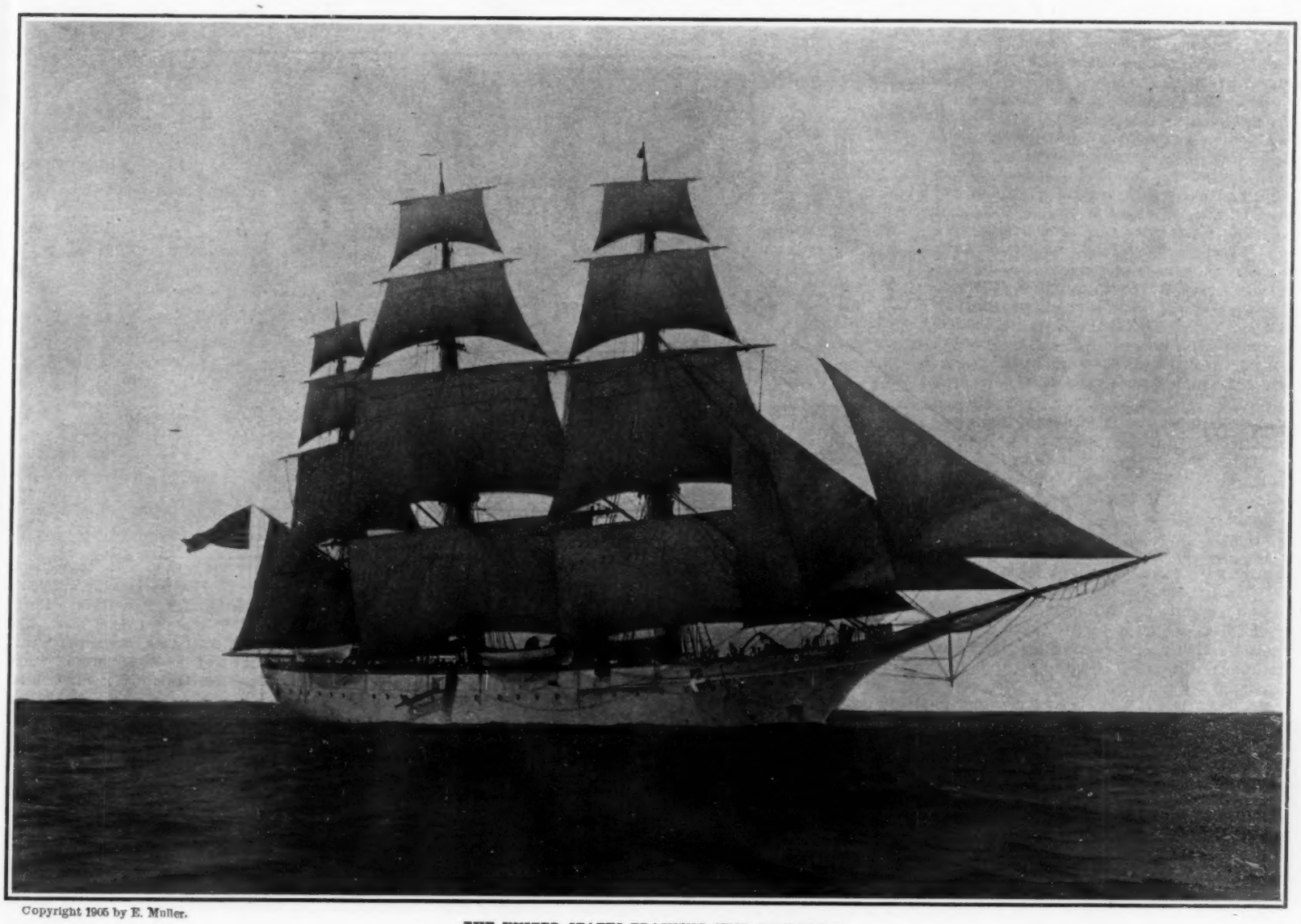
THE PRACTICAL WORK OF THE UNITED STATES BUREAU OF FORESTRY.

THE UNITED STATES TRAINING SHIP "SEVERN."

The United States navy possesses four training ships, the "Boxer," "Cumberland," "Intrepid," and "Severn," all of them of modern design and construction. The "Boxer" is a little brigantine, 125 feet 4 inches in length and of 346 tons displacement, now stationed at the training station, Newport. The "Cumberland" and "Intrepid" are sister ships, 211 feet 7 inches in length over all, and of 1,800 tons displacement. They are bark rigged, and each has a complement of 336 officers and men. The "Cumberland" is stationed at the navy yard, Boston, and the "Intrepid" at the navy yard, Mare Island.

The "Severn," which forms the subject of our illustration, is a steel vessel wood sheathed and copper bottomed. She was launched in 1899 at the Bath Iron Works, Maine, and her present duty is to serve as a practice ship for the naval cadets at Annapolis, where she is stationed. She measures 175 feet between perpendiculars and 224 feet 3 inches over all. Her beam is 37 feet; her mean draft 16 feet 6 inches, at which draft she displaces 1,175 tons. It will be noticed from her dimensions that she is a narrow ship, having only 37 feet beam to 175 feet of length, as against a beam of 45 feet 8 inches possessed by the "Cumberland" and "Intrepid" for a length between perpendiculars of 176 feet 5 inches. Because of her fine model the "Severn" is quite a smart ship, and in a good quartering breeze can do her 12 knots or over. As her duties are exclusively those of a training ship, the "Severn" has no armor protection; but she mounts a battery of six 4-inch rapid-fire guns; four 6-pounders; two 1-pounder automatics, and two 6-millimeter automatics.

In former days, we believe it was the custom to give the naval cadets their training in practical navigation and seamanship entirely upon the training ships, which made long ocean cruises for this purpose. At the present time, however, in view of the great change which has taken place in the character of the ships of our navy, machinery having taken the place of sail power, and the masts and elaborate running and standing gear having been practically all eliminated, the training of the cadets is accomplished by giving them short week-end cruises throughout the academic year in the "Severn" principally in Chesapeake Bay and by distributing them during the summer season upon various modern warships of the navy which are in commission, and so giving them the customary three months' cruise. In this way the cadets secure an amount of experience and knowledge of the practical working of a modern warship which could not possibly be obtained on a training vessel. For instruction in what is understood by the broad term "seamanship" the cadets are largely indebted to the all-day cruises in the "Severn" in the picturesque waters of Chesapeake Bay.



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THE UNITED STATES TRAINING SHIP "SEVERN."

Length over all, 224 feet 3 inches. **Beam,** 37 feet. **Draft,** 16 feet 6 inches. **Displacement,** 1,175 tons.

Acetylene Now a "Common Illuminant."

The rules formulated by the National Board of Fire Underwriters for the acetylene industry have hitherto required outside installation of acetylene generators; and while, as a matter of fact, in by far the largest part of the United States this rule has not been insisted upon, in certain limited sections it has been rigidly enforced.

The existence of a rule prohibiting the installation of an acetylene generator in an insured building was a constant menace and handicap to the industry, and its enforcement in some sections and not in others placed insurance companies in the inconsistent position of insuring property in one State under conditions which it would not accept in another. An investigation by the National Board, as to the exact condition of the industry, disclosed the fact that, in those sections where inside installation had been permitted, acetylene was proving itself to be a safer illuminant than those which it had replaced.

The National Board of Fire Underwriters, at its Executive Committee meeting on January 30, 1908, held in New York city, after considering the various favorable reports submitted to it by its various committees, amended the rules covering the installation and use of acetylene generators.

The rules now mean that in all outlying districts generators may be placed inside, but in closely built-up districts it recommended outside installation as its preference.

Even where outside installation is preferred, the rule regarding construction of generator houses has been modified; and where such houses formerly had to be fireproof, constructed of brick and located as far as practicable from other buildings, such houses may now be located adjoining an insured building, and fireproof construction is not required.

The investigations which were set on foot for the purpose of ascertaining facts brought forth the conclusion that, in view of the fact that the number of acetylene generators installed inside of buildings had very largely increased in the past few years, while, at the same time, the fire records seemed to show that the number of fires ascribed to such installations had if anything decreased, the rules of the National Board covering the construction and installation of acetylene apparatus had apparently safeguarded the hazard to a very great extent.

A $20,000 Transvaal Stope Drill Competition.

The Transvaal government, in co-operation with the Transvaal Chamber of Mines, has arranged for a practical trial of small rock drills suitable for narrow stoping work under the working conditions obtaining on the Witwatersrand.

All types of rock drills are eligible to compete. Drills using compressed air will be supplied with a pressure varying from 60 to 75 pounds per square inch at the working face. The mining regulations require the provision of dust-allaying appliances, and competitors must make provision accordingly.

Two prizes of $20,000 and $5,000 respectively are offered. The trials and the judging will be so arranged as to decide which machine performs the most economical work.

The competition will commence early in 1909, and entries will probably close with the end of 1908. The trials will last about six months, the drills being tested in the first instance on the surface, and those considered suitable being given a more prolonged test underground in several stopes in various mines on the Witwatersrand.

All inquiries should be addressed either to the Secretary, Stope Drill Competition, Transvaal Chamber of Mines, Johannesburg, Transvaal, or to the London Secretary, Transvaal Chamber of Mines, 202 Salisbury House, Finsbury Circus, London, E. C.

In a recent article, Mr. H. M. Hobart says the term "metallic filament lamp" is understood to refer to lamps consuming about 1.2 watt per candle-power, with a life of about 1,000 hours. He thinks, however, that in spite of the enthusiasm naturally aroused by their high efficiency, the drawbacks of metallic lamps, as at present utilized, are not sufficiently realized. The employment of such lamps on 200-volt circuits often means using more candle-power than is actually necessary, with a corresponding loss in economy. The greater concentration of the light in single high candle-power units is also a drawback. It is better to use five 10 candle-power lamps than one 50 candle-power lamp as regards distribution of light.

SOME PHASES OF THE PLANETS IN 1908.

BY PROF. FREDERIC R. HONEY, TRINITY COLLEGE.

The phases and apparent diameters of Mercury, Venus, and Mars are subject to great variations during their revolution around the sun; but owing to their greater distances from the earth, the changes in the apparent diameters of Jupiter and Saturn are not so marked; while those of Uranus and Neptune are barely perceptible.

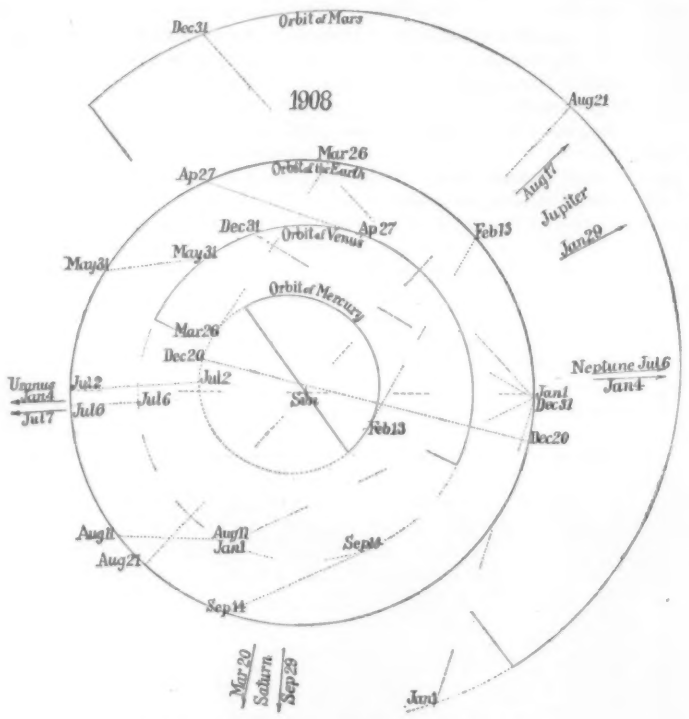
The brilliance of a planet depends upon its magnitude; its distance from the sun; its distance from the earth; and the extent of the illuminated area which is visible from our planet. On account of their great distance from the earth, the *major* planets always show their illuminated surfaces; therefore the phases are confined to the *terrestrial* planets.

The illustrations here given represent at the dates attached the apparent diameters and some of the phases of the planets during the year 1908. They are all magnified in the same proportion, and the scale selected is large enough to represent Neptune if the planet were visible when it is at its greatest distance from the earth in July. The representation of Neptune does not sensibly differ from his apparent size when he appears as evening and morning star, before and after conjunction with the sun; and when his distance from the earth is about one hundred and eight-six millions of miles greater than in January. The difference between the apparent diameter of Uranus in January and July is a little more marked than in the case of Neptune; due to the fact that the planet is nearer the earth. This effect of greater nearness to our planet is still more apparent in the disk of Saturn, which is here represented without the rings. In September, when Saturn comes to opposition, the maximum apparent diameter shows the effect of the diminution of his distance from the earth.

In the case of Jupiter, the apparent diameter in January, when the planet was at opposition, is very much reduced in August, when conjunction occurs. The apparent diameter of Saturn before and after March 20, and of Jupiter before and after August 17, when the planet in each case appears as evening and morning star, do not differ greatly from those which belong to the date (if the planet were visible) when the maximum distance from the earth is reached.

On January 1 Mars presented the gibbous phase, and was one hundred and twenty-seven millions of miles from the earth. The apparent diameter of the planet is very much reduced from that which it exhibited at opposition in July, 1907. It reaches its maximum distance on August 21, when if it were visible, it would appear as represented in the illustration. This diameter does not differ, however, very much from that shown before and after conjunction, when the planet is evening and morning star. In the last day of the year, Mars presents the slightly gibbous phase.

Venus divides the year into nearly two equal parts, as evening and morning star. She comes nearer the earth than any other planet; and when her minimum distance is reached on July 6, the apparent diameter (if the planet were visible) is represented by the measurement *a b*. On this day, Venus comes within twenty-seven million miles of the earth; but her dark side is toward us, and she is lost in the sun's rays. On January 1, when Venus was 135.2 million miles from the earth, she showed the slightly gibbous phase. During the first half of the year the planet is gaining on the earth at the rate of over half a degree a day; and as a consequence, the apparent diameter rapidly increases. Venus appears as a half moon on April 27; and her maximum brilliance is reached at the end of May, when she presents the beautiful crescent phase. After this the brilliance diminishes. In August, when Venus is morning star, and rapidly receding from the earth, the crescent phase is repeated, and is again seen to best advantage. The half-moon phase appears on September 14; and December 31, when Venus is gibbous, the apparent diameter of the planet does not differ very much from that of January 1.



Orbits of the Terrestrial Planets for 1908.

TABLE 1908.

Planet.	Diameter Miles	Date.	Mean Radii of Earth's Orbit	Distance in Millions of Miles
Neptune	34,800	January 4th	28.96	2690.3
		July 6th	30.96	2876.5
Uranus	31,900	January 4th	20.50	1904.0
		July 7th	18.53	1721.0
Saturn	73,000	March 20th	10.52	977.0
		September 29th	8.46	780.0
Jupiter	86,500	January 29th	4.33	401.1
		August 17th	6.37	592.2
Mars	4,230	January 1st	1.37	127.4
		August 21st	2.68	248.6
		December 31st	2.12	197.0
Venus	7,700	January 1st	1.46	135.2
		April 27th	0.71	65.7
		May 31st	0.44	41.2
		July 6th	0.29	26.9
		August 11th	0.45	41.4
		September 14th	0.70	65.0
		December 31st	1.41	130.9
Mercury	3,030	February 13th	0.95	88.1
		March 26th	0.88	82.1
		July 2d	0.56	52.3
		December 20th	1.45	134.4

The table gives the diameter of each planet, and its distance from the earth at the dates selected in the illustrations. This distance is given in terms of the mean radius of the earth's orbit or semi-major axis; and also in millions of miles. In the plot of the orbits of the minor planets, the position of the earth is indicated at each date, and a straight line is drawn to the planet's position on that day. The length of this line corresponds with that given in the table. Since the year 1908 has 366 days, the earth in the plot on December 31 comes very nearly to the same position as that of January 1.

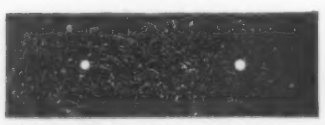
Mercury as evening star showed the half-moon phase on February 13; and again as morning star, on March 26. His minimum distance from the earth is reached on July 2, when the apparent diameter of the planet, if projected on the sun's disk, would reach its maximum for this year. Mercury's minimum distance from the earth is not reached on the day of inferior conjunction. The maximum distance is reached on December 20, which does not coincide with the date of superior conjunction. This is due to eccentricity of the planet's orbit. The apparent angular diameter of a planet, or the angle subtended by it, is directly as its real diameter, and inversely as its distance from the earth. In the computations of the diameters of the planets in the illustration, the unit distance employed is the mean distance between the sun and the earth, i. e., 92.9 million miles. At this distance, 450 miles subtends an angle of one second. One example will suffice to show how the apparent diameter of a planet is determined.

Neptune's diameter is 34,800 miles; and $\frac{34,800}{450} = 77.3$ sec. At a unit's distance from the earth, Neptune would subtend this angle. But at opposition, the planet is twenty-nine times the distance between the earth and sun; while at conjunction this distance is increased by the whole diameter of the earth's orbit. Therefore, the apparent diameter of the planet at opposition is $\frac{77.3}{29} =$ 2.66 sec.; and at conjunction $\frac{77.3}{31} = 2.49$ sec. The table gives the diameter of each planet, and its distance from the earth at the dates selected in the illustrations. This distance is given in terms of the mean radius of the earth's orbit or semi-major axis; and also in millions of miles. In the plot of the orbits of the minor planets, the position of the earth is indicated at each date, and a straight line is drawn to the planet's position on that day. The length of this line corresponds with that given in the table. Since the year 1908 has 366 days, the earth in the plot on December 31 comes very nearly to the same position as that of January 1.

A Detector of Ultra-violet Rays.

C. Schall describes, in the Photographische Wochenblatt, a photo-chemical method of detecting the presence of ultra-violet rays, based on the fact that these rays and no others produce a blue coloration on paper saturated with a solution of p-phenylene diamine. The paper can be prepared in, and freely exposed to, diffused daylight which merely gives it a pale gray tint. An instant's exposure to the rays of a Heraeus quartz lamp suffices to produce the blue coloration. The effect is prevented by the interposition of a thick plate of ordinary glass, which stops the ultra-violet rays. The paper is prepared by floating it on a solution of 1 part by weight of p-phenylene diamine in 14 parts of water and 4 parts of a 40 per cent solution of nitric acid. The paper should be dried quickly by the application of heat and used immediately.

The United States Geological Survey has recently issued a report dealing with the subject of smoke prevention, in which it is concluded that coal should be supplied to furnaces in small quantities at frequent intervals, and the air supply should slightly exceed the theoretical amount required for combustion. The temperature in the furnace should be sufficiently high to ignite the gases given off from the fuel, and boiler rooms should be managed by properly trained men.

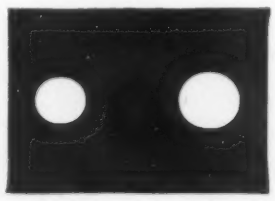


Uranus.

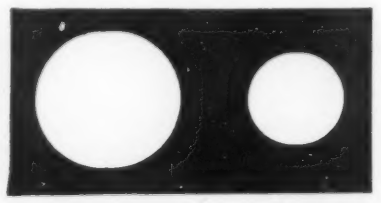
Neptune.

Mars.

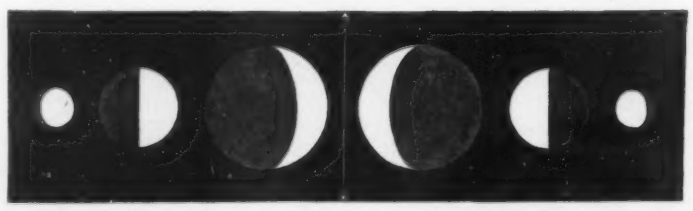
Mercury.



Saturn.



Jupiter.



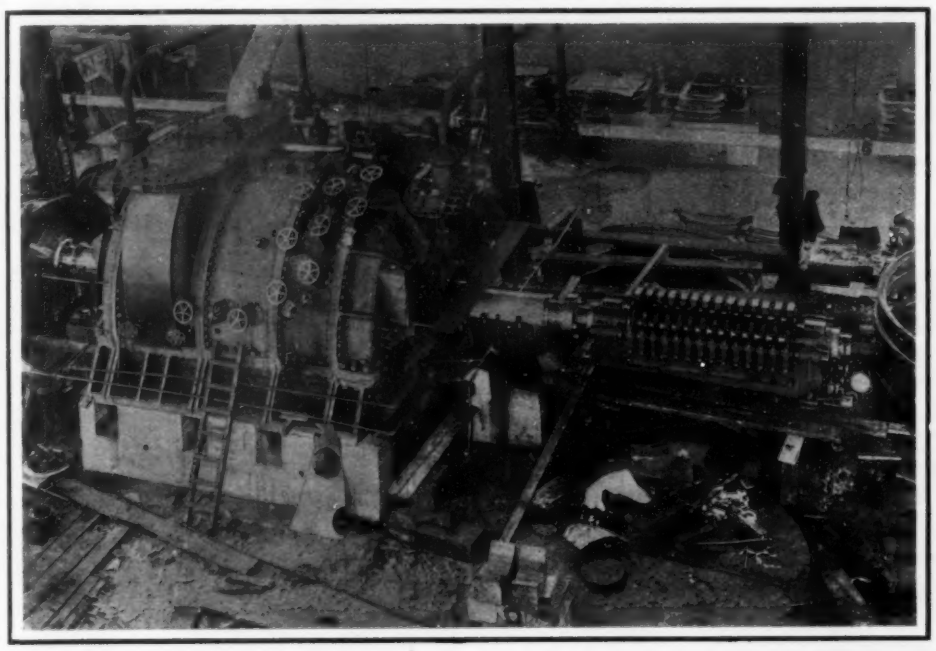
Venus.

PHASES AND APPARENT DIAMETERS OF THE PLANETS DURING 1908. THE FIGURES ARE DRAWN TO THE SAME SCALE.

AMERICAN TURBINES FOR THE JAPANESE ARMORED CRUISER "IBUKI."

The accompanying photographs of two large turbines now being built in the shops at the Fore River Shipbuilding Company should possess a special interest for American readers. They will form the motive power for the latest of the new Japanese armored cruisers, the "Ibuki," a fine vessel of 14,600 tons displacement and 22 knots speed, which is now nearing completion at the yards at Kure, Japan. The significance of these engines lies in the fact that they are the first large marine turbines to be installed in a Japanese warship; and it is a distinct indorsement of the progress made in this country in the development of the turbine, that such an astute people as the Japanese should have selected the Curtis type for the motive power of so valuable a ship. The "Ibuki" and her sister ship "Kurama" are identical vessels, with a length of 450 feet, a beam of 75½ feet, and a mean draft of 26 feet. We understand that the "Kurama" is being equipped with reciprocating engines, and therefore in these two vessels will be afforded an opportunity to test the respective efficiency of the two types of motor.

The later ships of the Japanese navy, which are being built by the Japanese themselves, are distinguished, like the ships of our own navy, by the unusually heavy batteries which they carry. Thus, the "Ibuki" mounts four 45-caliber 12-inch guns in two turrets; eight 8-inch 45-caliber guns in eight single turrets; and fourteen 4.7-inch guns, ten of them in a central battery, and four in casemates, two at the bow and two at the stern. The ships are protected by a 7-inch belt and a 2-inch armor deck. The 12-inch gun turrets have 7 inches protection, the 8-inch gun turrets 6 inches protection, and the 4.7-inch guns are mounted behind 5 inches of armor.



Twenty-seven Thousand Horse-Power Turbines for the Japanese Cruiser "Ibuki."

The motive power of the "Ibuki" consists of two turbines, which are designed to develop a normal horse-power of 24,000, sufficient to drive the "Ibuki" at 22 knots speed. They are intended, however, to develop a maximum overload horse-power of 27,000, which should suffice to give a speed of nearly 23 knots. The rotor is 144 inches in diameter. The casing has an outside diameter of 14 feet, and a length over all of 17 feet. The weight of the two turbines together is 360 tons.

Each turbine consists of a cast-iron cylindrical casing divided by dished diaphragms into a series of separate compartments. In each compartment or "stage" there is a separate wheel, which carries on its periphery three rows of moving buckets (for reasons later described the first wheel has four rows). The wheels are all mounted on a hollow steel shaft carried by two bearings. Where the shaft passes through the diaphragms, they are provided with bronze bushings having a small clearance, thus preventing appreciable steam leakage from one stage to the other. Where the shaft passes out through the ends of the casing, it is provided with carbon stuffing boxes, which prevent steam leaking out at the ahead end, or air leaking in at the back end where a vacuum exists.

The stuffing boxes are supplied with steam in the space between the carbon packing, to prevent air leaking in and lowering the vacuum. They are also drained to the fourth-stage shell.

Cast-steel steam chests for ahead and astern running are attached to the front and back casing heads as shown, and are flanged for the main steam pipes. The nozzles for each stage are bolted to the diaphragms, the diaphragms having steam-port openings cast in them to allow the steam to pass through to the nozzles.

Maneuvering is accomplished by means of two lever-operated balanced throttle valves, each taking steam from the main steam pipe, and one delivering to the ahead steam chest and the other to the astern steam chest. There are seven ahead wheels and two reverse wheels. The reverse wheels are mounted in the after end of the casing, and under ordinary ahead running they are in a vacuum, and therefore do not waste power by steam friction. They are similar to the ahead wheels, except that the blades are reversed. To reverse when going ahead, the ahead throttle valve is shut and the reverse throttle valve opened, which is easily and quickly accomplished by the operating levers of the two throttle valves.

Drain pipes are provided, connecting each stage with the next, so the condensed steam in any stage will pass to the next one of lower pressure, and there give up a part of its heat to do useful work. The exhaust chamber drains to the condenser, and the discharge is assisted by a small steam ejector. A regular marine thrust bearing is attached to the forward end of the turbine shaft. In addition to taking the propeller thrust, this bearing also maintains the proper axial position of the rotor, so that the axial clearance of the blades is correct. This clearance is one-tenth of an inch on the first wheel, and increases to one-quarter of an inch on the seventh wheel. The thrust is put at the forward end, so that any unequal expansion of the shaft and casing will be allowed for at the aft end where the clearance is largest. This axial clearance is very ample to allow for all unequal heat expansion that may occur, and any mechanical irregularities, and leave sufficient leeway for adjustment.

To allow for the increased volume of the steam as it expands in passing from stage to stage at lowering pressures, the lengths of the blades are increased, and also the arc of the nozzles is increased, thus giving greater area of passage in each succeeding stage. Also, in any one stage, the blade lengths are increased in each succeeding row, because the velocity falls as the steam passes from row to row, although it is at practically constant pressure throughout the stage.

In order to keep the pressure in the shell as low as possible, the pressure distribution is arranged so that one-fourth of the available energy of the steam is expended in the first stage, and one-eighth in each of the other stages. This requires the first-stage nozzle to be of the expanding type, but all the other nozzles are of the parallel-flow type. Also, the first-stage wheel is provided with four rows of buckets instead of three, as on the other wheels, since the greater energy drop produces greater velocity of the steam jet from the nozzles, which requires more rows of buckets to properly absorb the energy at the bucket speed used. This arrangement makes all the ahead wheels except the first operate under eight-stage conditions. The principal advantages of the Curtis design of marine steam turbine are as follows:

Small number of blades.

Large clearance around blades.

Strong mechanical construction of blading.

Economy at reduced speed, without cruising turbines.

Interior of shell not subjected to full steam pressure.

Low revolutions for given horse-power.

Absence of dummy pistons and packing.

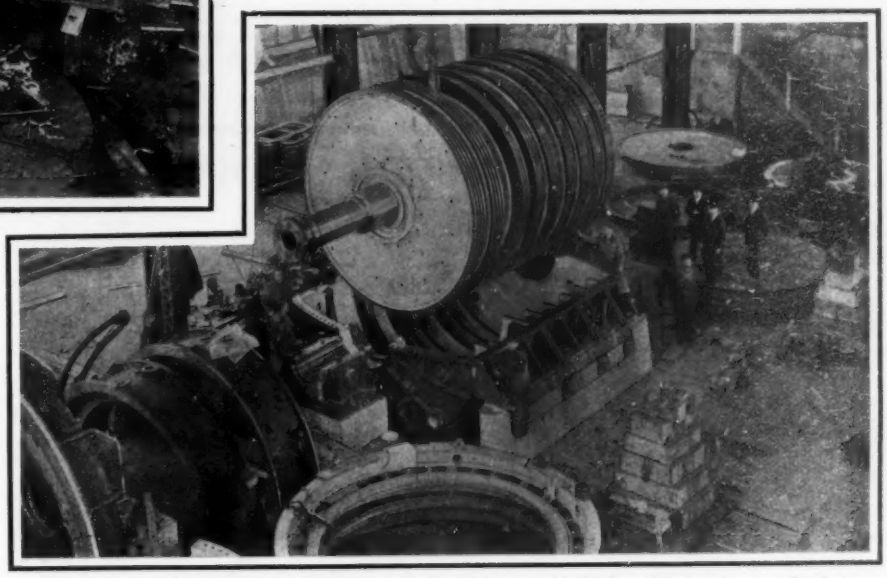
The small number, large clearance, and strong construction of the blades make blade stripping practically impossible, and no case has occurred.

By the use of valves on the nozzle openings of the diaphragms, the proper steam pressure distribution can be maintained at reduced steam flow, thus keeping up the economy at low speed of vessel, except, of course, for the unavoidable loss due to lower revolutions and dispensing with cruising turbines.

Full steam pressure comes on the steam chest only, which is a comparatively small steel casting. The greatest pressure in the turbine shell is less than one-third the working steam pressure. This permits high steam pressure to be used, and large turbine diameter in comparison to the power. It also reduces expansion difficulties.

The comparatively low revolutions permissible for a given power without sacrifice of economy, or excessive weight, allows the twin-screw arrangement to be used instead of three or four screws. Also, other conditions being the same, lower revolutions will give a higher efficiency of the propeller. Low revolutions also permit the use of turbines in comparatively (for turbine vessels) low-speed vessels.

Absence of dummy pistons and their packing eliminates the leakage of high-pressure steam and makes the economy independent of any adjustments, so that the initial economy will be maintained continuously and will not be affected by any wear.



The Rotor and the Lower Half of Casing. Rotor, 144 Inches in Diameter. Casing Measures 14 Feet in Diameter by 17 Feet in Length.

AMERICAN TURBINES FOR THE JAPANESE ARMORED CRUISER "IBUKI."

An Old-Time "Taxi-cab."

The taximeter cab, or "taxi-cab" as it is called in New York, is quite the latest thing in the streets of our modern cities. And yet the old adage "there is nothing new under the sun," is peculiarly applicable to what we are all inclined to imagine is the product of the twentieth-century brain. An Oriental contemporary (Ostasiatische Lloyd) states that the Chinese can prove, from one of their old richly illustrated historical works, that already in the eleventh century they had invented and were using a "giligulicha" (or "counting mile drum car") which possessed many of the features of the modern taxicab. Judging from the several illustrations of the "giligulicha," contained in the famous "Tsan-thu-hae" collection of pictures, the vehicle had one single pole or shaft, ran on two wheels, and consisted of two stories. In each of these compartments or divisions there was a wooden figure holding a mallet in the right hand; these mallets were arranged to strike upon a drum in the lower story, and upon a gong in the upper one. When the vehicle had traversed a certain predetermined distance, the lower figure struck the drum with its mallet, whereupon a cog-wheel made a revolution. When a distance of ten miles had been covered the upper figure struck the gong with its mallet. In some cases this Chinese taximeter car was also fitted with a compass which, owing to the total lack of landmarks and signposts, was of great value to the Celestial "chauffeur" of that time. A magnet was also provided; it was located in a small box, and influenced a block upon which there was fastened a small jade or wooden figure the outstretched arm of which always pointed due south.

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Loom multiplier mechanism, E. H. Ryon	884,862
Loom, narrow ware, E. H. Ryon	884,614
Loom shedding mechanism, E. H. Ryon	884,613
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Mail crane, A. C. McCord	884,407
Mail matter stamping and sealing machine, Morris & Hall	884,837, 884,838
Mail pouch delivery device, W. A. Virgils	884,782
Malt by means of chlorid of lime or other hypochlorite salts, preparing, J. Effront	884,725
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Matches, making bodies for wax, T. Lara	884,506
Measuring instrument, electrically-synchronized time, Bonniksen & Chandler	884,358
Measuring the degree of exposure of a selenium cell, A. Korn	884,501
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Mechanical movement, C. F. Jones	884,590
Mechanical movements, casing for, J. Edens	884,647
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Metallic compounds, electrolytic reduction of, H. Rodman	884,763
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Musical instrument of the accordion type, A. J. Engelm an	884,373
Musical instruments, duplex tracker-board for automatic, M. Clark	884,366
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Necktie turner, W. J. Dryden	884,910, 884,911
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Nitrogen oxids from air, making, Grau & Russ	884,919
Nut lock, H. E. Shrock	884,531
Nut lock, C. Kesler	884,933
Nut lock, L. J. Lindsay	884,983
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Ores, separating the liquid from the solid portions of treated, E. P. Lynch	885,004
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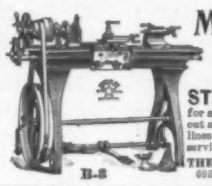

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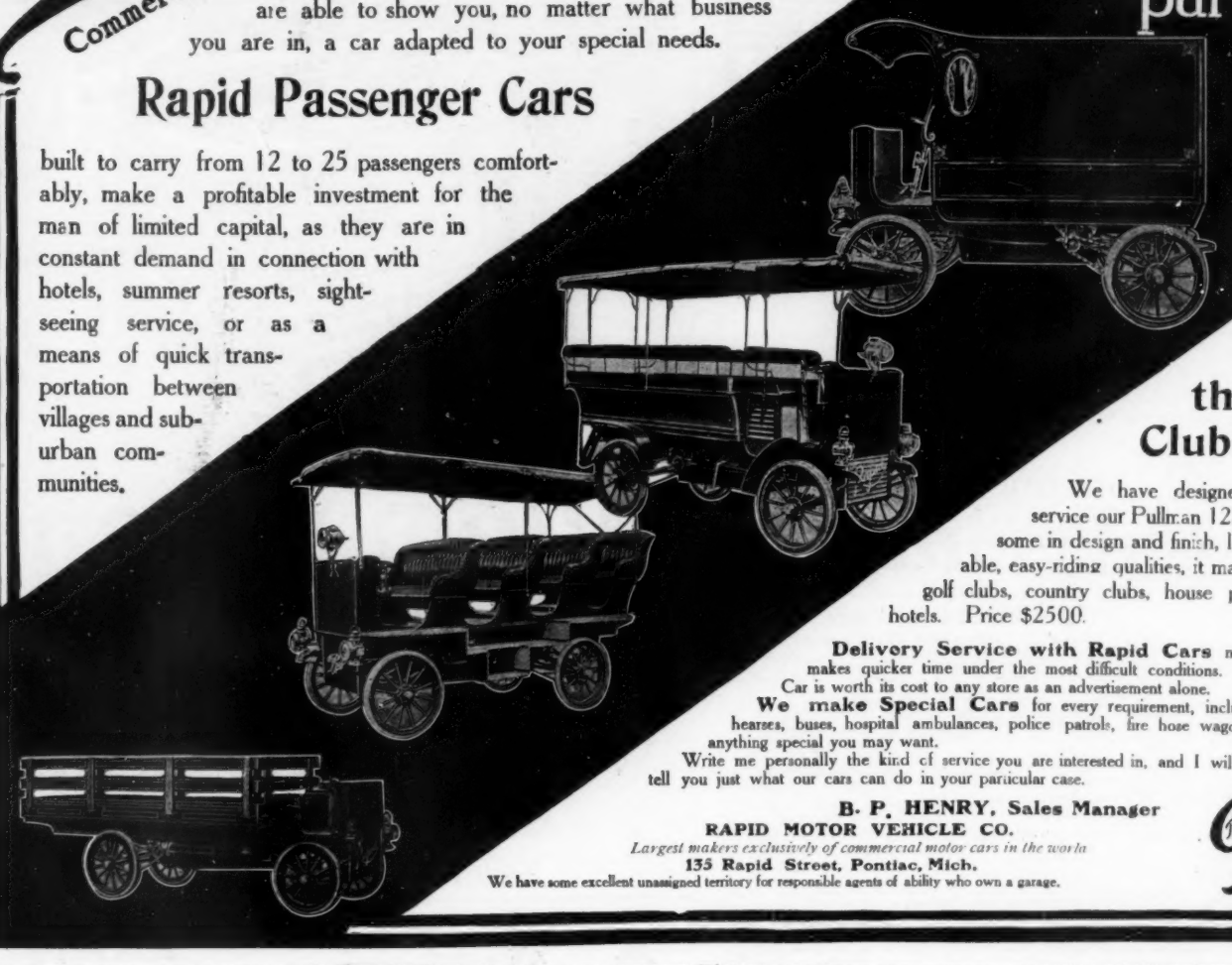

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Copper and brass sheets and wire, Michigan Copper & Brass Co. 68,481
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Disinfectant, sheep-dip, and cattle wash, W. Cooper & Nephews 68,513
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Dolls and stuffed toy figures, Margarete Steiff, G. m. b. H. 68,568
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Gas generators, acetylene, R. P. Elliott 68,547

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REVERSIBLE STEAM TURBINE PROMOTER wanted. Address Hornig, 139 Clinton Ave., Jersey City.

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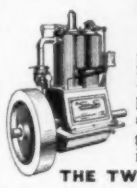

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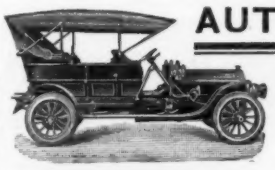

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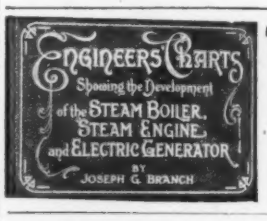

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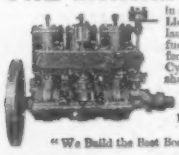

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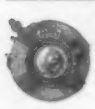

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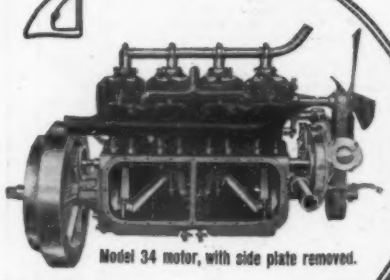

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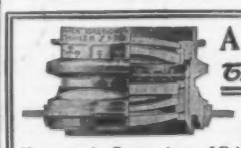

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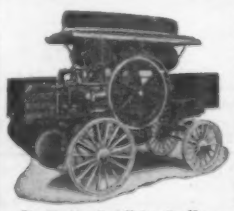

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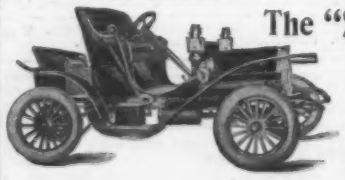

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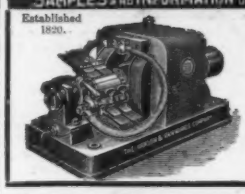

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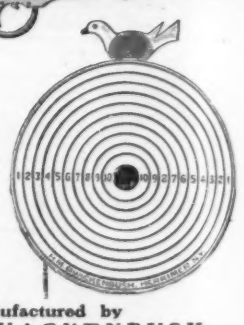

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